Part 1

Financial Modelling

Structure and Mechanics of Developing Financial Models for Corporate Finance and Project Finance Analysis

Part 1:
Financial Modelling:
Practical Development of Cash Flow Forecasts

Chapter 1: Financial Modelling and Recurring Valuation Nightmares – Problems that Financial Models Cannot Solve

An inevitable step in just about any financial analysis is making some kind of explicit or implicit projection of cash flow and/or earnings and/or various financial ratios. Since valuation of debt or equity is all about making forecasts of these items, you could go to a fortune teller or read the astrology section of your on-line newspaper to make your prediction of the future. These days however, forecasts used in valuation are more often founded on fancy financial models built using elaborate spreadsheets. After bursting of the dot com bubble in 2001, the global financial crisis of 2008, the European debt crisis in 2010, the East Asian crisis of 1997 and innumerable other less famous valuation disasters where debt and equity investment failures had relied on sophisticated financial models, it could be argued that going to astrologers and fortune tellers would have been a better strategy. Notwithstanding serious questions about the overall efficacy of making financial projections, the fact is that financial models are becoming more and more complex and are also being used more than ever before in all types of investment analysis. Seemingly sophisticated models using elaborate programming functions can appear impressive and even artistic, but at the same time be almost impossible to use in assessing risk and value. Given the prominence of modelling in financial analysis, this part of the book describes how to build flexible, accurate, structured and transparent financial models that can be used to assess various different valuation problems.

When considering many valuation mistakes made in the past decades, the most important pitfall in modelling is the development if economic assumptions for prices, volumes, capital expenditures and operating expenses. When you step back and think about all sorts of financial failures ranging from the global financial crisis to bankruptcies of small business enterprises to industry specific failures such as solar panel manufacturers, there are a few patterns of mistakes that are repeated over and over again that seem obvious after the fact. Before delving into sophisticated mathematical equations, excel techniques and model structure issues that deal with methods to resolve difficult project and corporate finance and project finance modelling challenges, it may be worthwhile for you to think about why the outcomes of financial analysis using financial models sometimes fail so miserably and leave these ideas somewhere in the back of your brain while you create the ornate excel models. Some recurring valuation mistakes that continue to be made despite more and more sophistication in financial analysis and financial modelling are listed below:

(1) Making assumptions in financial models that companies which are earning a rate of return substantially higher than their cost of capital and are growing quickly can continue this financial performance even where they do not have some kind of sustained competitive advantage. Earning a higher return than the cost of capital and growing seems to put a company in the famous powerhouse square on management consultant power point slides that is supposedly the best place to be for valuation. But when returns and growth are high, other companies from all over the world will attempt to enter the industry no matter how unique the company claims to be. This often leads to industry-wide over-capacity followed by reduced prices and sudden dramatic declines in returns. If demand growth is slower than expected which happens more often than not, the over capacity and depressed prices can last for many years. Examples of high growth and returns leading to industry expansion followed by surplus capacity and price crashes – the most basic economic principles -- include the famous telecom industry meltdown in the late 1990’s; the merchant electric power crash of 2000-2001 in the U.K where virtually every electricity plant without a fixed price contract defaulted on its debt; the real estate industry during many periods most notably

before the U.S. crash of 2008; and, more recently where very high returns for solar manufacturing companies followed by massive new entry and dramatic price declines; high returns earned by bulk cargo vessels before 2008 followed by overcapacity and depressed prices that have continued long after commodity prices and other industries recovered; and depressed occupancy rates and room rates for hotels in Iquitos Peru that followed a period of over-building that was supposed to occur because of the region receiving UNESCO heritage site status.

(2) Entering projected prices in financial models that remain above the long-run cost of production even when capacity is increasing in an industry. One can define a price bubble as a situation where prices do not equal long-run marginal cost and/or values are not consistent with levels that provide investors with a reasonable return on their investment. Assuming that prices can be sustained above marginal cost happened before the U.S. real estate crash where people believed they could profit by buying and selling (or flipping) homes; it occurred during the famous Tulip bubble in Holland in the 17^{th} century; it may be happening in U.S. natural gas prices above the marginal cost of producing shale gas; and the assumption that prices could remain above marginal cost was behind just about all of the valuation mistakes discussed in the last paragraph ranging from the telecom industry crash to overproduction of container ships.

(3) Using information in financial models that relies on so-called independent experts whether these people or institutions are credit rating agencies, large reputable corporations, consulting companies that create very fancy analytical models, experts speaking on television, famous finance professors or former politicians. Many valuation nightmares have demonstrated after the fact that it is more important to visit countries, meet with real consumers, try out products and services, and have a through independent understanding the business idea than relying on so-called experts when developing projections. Reliance on entities like rating agencies was not only a cause of the global financial crisis of 2008, but has also occurred with traffic studies made for project financings such as the Eurotunnel, toll roads and toll bridges all over the world, theme parks and countless other cases. The famous Panama Canal catastrophe where French investors lost so much money in the 19^{th} century resulted from trusting a famous engineer who had only visited Panama once. Relying on the reputation of companies that were thought to be the most innovative in their industry like ENRON, Worldcom and Lehman Brothers without thinking through the fundamental economics turned out to be very dangerous.

(4) Trusting financial model results where increasing returns are projected by a company but the returns only come about because the company is taking on increased risks. Companies with declining returns or lower margins than peers often desperately try increase or maintain equity returns. But these companies (or individuals) can generally only meet their return objectives by take increased risks and then trying to hide those risks. When taking on ventures or deploying capital that involves taking greater risk, it is tempting for companies to directly or indirectly cover up the risks through not fully disclosing things or worse, using very sophisticated and confusing financial language along with financial models that are impossible to understand. Examples of valuation errors caused by presenting confusing information include Constellation Energy in 2006-2008, Enron’s impossible to understand financial statements and innumerable financial institutions that made risky loans or engaged in risky trading behaviour to boost their returns before the financial crisis.

(5) Ignoring shifts in the cost structure and demand change when creating a model which can quickly render existing assets obsolete. This is a particular problem in oligopolistic industries where seemingly stable returns and cash flows can suddenly change on the whim of management actions or changes in consumer taste. Think about Nokia, Research in Motion (blackberry) and Apple. A few years ago Nokia was rave of investors and the company was assumed to have unique products that would yield a sustainable competitive advantage and strong returns over an indefinite period. Then Nokia lost its lustre and Research in Motion

was the poster child for investors. A few short years later, RIM lost its popularity and Apple became the most valuable company in the world as it somehow made people even more addicted to their cell phones. Commodity industries may be very volatile and not offer extraordinary returns, but at least you can apply basic economic principles when thinking about prices volumes, industry capacity and market demand.

(6) Putting faith in fancy, complicated and innovative new financial paradigms when creating financial models. At the turn of the century the so called new economy was supposed to replace traditional analysis using cash flow and rate or return relative to cost of capital. At the time the new economy principles could explain why dot com companies do not need cash flow or profit to generate value; real option models were used to justify new peaking power plants that did not make economic sense using traditional discounted cash flow analysis; Collateralised debt obligations could supposedly could somehow reduce risk by putting a bunch of skanky loans to people who could not repay them. When such new models cannot be explained in simple terms and when the models explain why one can somehow earn high returns without having a sustained competitive advantage, they almost always turn out to be rubbish.

(7) Having confidence in contracts that do not make economic sense and incorporating those contracts in financial models. Financial contracts that turned out to be unsustainable included sub-prime loans issued before the financial crisis, electricity contracts called PPA's in Senegal, India, Indonesia, the U.S.; the Philippines and many other places; construction contracts for large complex projects such as Eurotunnel and Eurodisney that are chronically underestimated; oil projects where ownership structures resulted in extreme economic profit for private investors; and, financial subsidies from governments in Spain and the Czech republic that lead to very high returns for project developers. In each of these cases financial projections made by analysts assumed contracts that would remain in place even though the contracts allocated risks in crazy ways and lead to prices and returns that were far away from economic reality.

(8) Inputting symmetric upside case and downside assumptions in models without adequately considering differences in upward limits and downward exposures that create skewed returns. Not properly accounting for deviations between upside and downside variation led to the California crisis in electricity prices in 2000-2001; underestimating exposure to risk of nationalisation when oil prices are low; retiring large plants when prices are low and have much more potential movement to the upside than to the downside.

Chapter 2: How to Read this Book in Different Ways so You Can Learn Rigorous Valuation Techniques and Become a Black Belt Modeller

The four parts of this book explain how to: (1) build and interpret corporate finance, project finance and acquisition financial models; (2) perform risk analysis using all kinds of financial models; (3) use mathematical programming to resolve circular calculation problems in corporate and project finance models; (4) analyse multiples, terminal values and normalised cash flow in deriving value from corporate models; and, (5) compute long-run marginal cost for purposes of developing price assumptions in financial models. While the descriptions along with practical exercises of these subjects will hopefully help you to avoid some of the famous pitfalls discussed above, mechanical construction of the best financial models in the world has little direct effect on the recurring human mistakes discussed above. When working through the structure, programming and particularly the analysis of a variety of corporate and project finance issues the hope is that you will place these classic patterns of valuation mistakes somewhere in the back of your brain. Because of the importance of the recurring valuation mistakes, the introduction to various subjects in the four parts of the book will periodically return to these issues.

The four subjects involving the structure and creation of different types of financial models; alternative risk analysis using the models; corporate valuation mechanics to derive multiples and terminal valuation from models; and marginal cost principles for deriving economic assumptions. To describe these topics, this text covers corporate finance models, project finance models and acquisition models. You may be wondering whether the subject is too broad and if some of the intricate issues that arise in different modelling contexts can all be adequately addressed in a single book. The philosophy of discussing different types of models and valuation analyses is that you can learn creative modelling techniques and understand why certain model structures are used through contrasting the different general categories of financial models. Further, while one can make generalisations about the different modelling categories, many transactions and analyses have overlapping aspects of project finance, corporate finance and acquisition finance. An investment may be initially structured using project finance concepts; it may then gain characteristics of a corporate finance analysis as it develops a history and expands into other activities. After the corporation has existed for a few years it may consider acquiring new companies requiring acquisition analysis.

As much of this text is designed to be a practical reference guide on how to structure and build models there are a number of ways to read the book. One way you could read through different chapters without touching an excel sheet. This may not be very exciting and would be something akin to reading a cook book without trying out the recipes. A second way to read the book is to work through one of the many of the accompanying models while you tackle the various issues. More than a hundred customised exercises with instructions along with template project finance, corporate model templates and acquisition model templates are included on the web site. In addition there are many completed examples that may be the most helpful tools in learning how to most effectively become a truly top notch modeller. These exercises, template models and completed model examples are an integral part of this book. A third way to use this book if you already have experience in modelling is to treat it as a reference manual that where you can selectively look up difficult modelling issues such as modelling a debt service reserve account without any circularity or writing a function to deal with retirements of assets and accelerated depreciation.

Probably the only real way to learn financial modelling is working late at night under a tight deadline under the pressure of a transaction. Real modelling is not a linear process, but involves gathering information, focusing on data that is relevant and coming up with ways to best represent the revenues and earnings of a business given sometimes very limited available information. The process of developing the top line -- revenue from volume sold and capacity – is, and certainly should generally be, the most time consuming and important part of the model that requires a lot of time and creative thinking. Notwithstanding the non-linearity of the real-world modelling process, outlining the structure of models and presenting real world examples in this chapter can provide a head start for those who have not built models and will eventually have to learn the hard way.

The principal objective of this part of the book is to provide you with practical instructions on how to build a well structured financial model that clearly delineates inputs, effectively presents key value drivers, uses separate modules to organize various components in a logical manner, accurately computes cash flow that is available to different debt and equity investors, and presents results of the analysis that effectively represents risks of the investment. A bit of theoretical discussion of how different types of models can be used to establish value is included, but the main objective is simply to provide details on how to build better models. In discussing the process for building an efficient financial model, this part of the book is organized into the following sections which correspond to general structure of a financial model:

- Model objectives and the general notion of keeping models simple
- Structure and layout of alternative types of models
- Avoiding bad spreadsheet programming practices
- Organizing time periods in a model
- Projecting revenues, expenses and capital expenditures in a working analysis
- Developing free cash flow through adding fixed asset modules and working capital

- Programming the debt schedule and incorporating cash flow waterfalls that establish the priority of payments to different capital providers
- Creating the financial statements projected tax payments
- Generating a balance sheet and other auditing tools
- Programming difficult project finance issues associated with sculpting, DSRA, funding and re-financing

Some of the subjects discussed in this chapter such as organizing time periods of the model, using techniques to verify the accuracy of mechanical calculations and computing tax depreciation are not very glamorous. While these topics may not have dramatic effects on valuation, use of good modelling practice can improve the efficiency of the process and allow you to spend more time on the important issue of risk analysis. There are many practitioners who have created models the wrong way for a long time who can attest that a few simple ideas regarding structuring and programming models can dramatically improve the operation of a model and ultimately improve valuation analysis.

Chapter 3: General Model Objectives of Structuring Transactions, Risk Analysis and Valuation and Keeping Models as Simple as You Possibly Can

Financial models have three general objectives that should be placed in the back of your mind before you start writing any excel formulas or developing any assumptions. These are: (1) coming up with the expected value of an investment; (2) assessing the risk of the investment; and (3) developing the financial structure of the investment. Effective assessment of risk is the centrepiece of valuation and the most fundamental reason any financial model is created. Believing that all risks can be avoided in any aspect of your life is dangerous and generally leads to poor judgment and bad decisions. Taking measured risk is a fundamental fact of life and in economic analysis financial models can hopefully help your judgment in accepting risk. Once you have attempted to measure risk, you can see what kind of debt and value correspond to the risks. This leads to the final and aspect of valuation that derives of implied value or cost of capital through measuring debt capacity and/or a set of financial statistics such as P/E ratios.

Given the importance of risk analysis in valuation, one of the two central objectives in building a model of future cash flows is to assess risks in a transaction, whether the transaction is simply purchasing a stock, borrowing money, investing in an airport, acquiring a company or signing a contract. The second general objective of building a financial model corresponds to the inference of risk from debt capacity and structuring of transactions mentioned above. Structuring a transaction using a financial model as a tool may mean sculpting debt repayments in a project financing transaction, sizing the senior debt in a leveraged buyout, developing the share exchange ratios in a merger or simply evaluating the reasonableness of P/E ratios when valuing a stock. Depending on the valuation approach, the analysis may address risks to equity holders, risks to senior debt providers or risks to other parties such as contract counterparties. Finally, even if you are an “excel phoebe” you should be able to understand financial models and make informed decisions about the risk of a security.

After the financial crisis of 2008 some have suggested that risk analysis of complicated investments is simply too difficult and opaque for average investors to understand. Investment bankers had supposedly created dangerous overly-complex products that could not be modelled or analysed. To model risks of these structured investments (so named because they split-up or structure operating cash flows to different investors) financial models had to be created that not only measure operating cash flow, but also who gets the cash flow in what order in alternative states of the world. Modelling the risks of CDO’s was famous for being “confusedly elegant” and relying on complex statistics that are all but impossible to interpret. The outputs of fancy statistical analysis was sold as really representing economic behaviour and sophisticated models that measured value at risk and the probability of default gave people a false sense of comfort that they could take risks which in hindsight turned out to be silly. By working through the financial modelling mechanics in this chapter, you should see that valuation errors made because models or studies are incomprehensible are no excuse for poor risk assessment. Building a financial

analysis were one sees which investor receives cash flow in what order and then performs risk analysis even for a toxic collateralized debt obligation is not difficult if you are careful with the structure of the model. Financial modelling is not very complex or mysterious even though financial modellers sometimes seem to be involved in a conspiracy that makes the analysis impossible to understand. Hopefully, the modelling discussion follows Warren Buffet's comment that: "Business schools reward difficult complex behaviour more than simple behaviour, but simple behaviour is more effective."

Some rather complicated modelling techniques are presented in this chapter, but the most important modelling ideas that meet the risk analysis and financial structuring objectives involve relatively simple programming techniques. Later sections of the chapter do work through a few complex modelling issues (cash flow waterfalls, accelerated depreciation, debt defaults, tax loss carryforwards, capitalized interest and sculpting debt). Notwithstanding the importance of programming complex financial concepts in an elegant manner, a fundamental aspect of an effective model remains to keep the analysis as simple as possible. A professional modeller put it like this: "financial models must be as simple as possible, but no simpler."[1] Instead of worrying obsessively about small details in a model, it is generally better to concentrate on assuring that risks of key variables are effectively presented alongside the value statistics.

After the financial crisis, there has arguably been a movement away from elaborate mathematical models back to fundamentals and creation of more simple models. The quote below (from the Financial Times) illustrates the folly of overly complex models used by Moody's in evaluating a certain type of structured debt (a CPDO). The complex model used to establish ratings contained a bug led to major problems in risk assessment[2]:

> *A single small error in the computer coding that Moody's used to run its CPDO performance simulation had thrown the results way off. When the error was corrected, the likelihood of CPDO default increased significantly. CPDOs, it turned out, weren't triple-A products at all. Preliminary results suggested the error could have increased the rating by as many as four notches.*

In order to manage the discussion of different modelling issues associated with risk analysis and debt structuring, financial models are broadly categorized into three different types for purposes of the discussion – deterministic models, stochastic models and back of the envelop models.

Deterministic Models: Deterministic models are the kind of models most of us are familiar with. Even with all of the methods presented below to make the models transparent and logically structured, these deterministic models can become large and difficult to audit. Risk analysis in deterministic models is generally computed using judgmental assessments about how selected variables can change relative to base case assumptions.

Stochastic Models: Stochastic models build on deterministic models but include probability distributions around key variables. The probability distributions depend on relatively sophisticated mathematical analysis of economic variables and their correlation with one another. (Chapter 3) After the stochastic variables are added to a financial model, one can compute probability distributions associated with key valuation measures such as rate of return or probability of default. For example in analysing a hotel, one could assess the probability distribution of future occupancy rates and convert those to a distribution of rates of return.

Back of the Envelope: Simple back of the envelope models can be more important than the other two model types. These models may involve developing some kind of metric to check whether the complex model results are reasonable or they may involve

[1] Caroline von Schmalensee, FAST Modelling Standards, Coordinator: Version: FAST01a: 03 March 2010 http://www.FASTstandard.org/

[2] FT: When junk was gold (rating agencies and sub-prime), By Sam Jones. Illustrations by Balint Zsako, Financial Times, Published: October 17 2008.

simple statistical checks of the valuation. For example, in valuing a hotel one could calculate the value per room and assure it is reasonable relative to the costs of other similar hotels. Alternatively you may compute the return on investment on a year by year basis and think about whether it is really possible to earn the returns given the competitive structure of the industry. Coming up with effective ways to make simple analysis that checks a model can require more creativity and be more difficult than the other models.

Large deterministic and stochastic models built in excel generally receive the most attention when making valuations while simple back of the envelope models seem to be less and less part of the process. The description of modelling methods in this chapter and the next do address the first two model types: deterministic models and stochastic models without emphasizing the importance of making simple checks of the reasonableness of the result. This however does not in any way mean that back of the envelope models should be considered less essential in the valuation process. In fact, developing simple models – and simple is in no way synonymous with easy -- may be more important than any of the other analyses. Proving a valuation concept with a relatively simple analysis should take place at both the beginning and the end of the analysis.

The importance of back of envelope checks is illustrated by a case where an RFP was used to acquire bids for the purchase of exiting electricity plants. The electricity plants were sold by a company named Central Main Power Company ("CMP") and the company that "won" the bid by paying $886 million for the plants was named FPL Energy. The plants being sold were old and consisted of 1,185 MW; the largest plant in the portfolio was an oil fired plant in the U.S. State of Maine named the Wyman plant (594 MW) which had entered service about twenty years earlier. When selling the plants, CMP used an auction process which of course came along with a strict deadline for submitting bids. FPL was able to buy the Wyman Plant by making a bid that was higher than the bids submitted by other companies. FPL most probably used very sophisticated projections of future electricity prices, transmission constraints, and natural gas prices along with a big deterministic financial model in coming up with its bid. As is common in this sort of analysis, the modelling was likely finalized late at night and everyone was probably very tired. In the end, the FPL bid for the old oil plant and the other used plants of $748/kW was a lot more than the cost of brand new and much more efficient natural gas combined cycle plants which were being constructed at a cost of less than $600/kW.[3] According to rumour, FPL's sophisticated models contained errors that resulted in the high valuation. A back of the envelope analysis would have developed an approximate valuation by discounting the cost of a new plant to consider age and efficiency factors. Little more than a year after the purchase, FPL took a $176 million write-off as a result of paying too much for the CMP assets.[4] In this situation, a much simpler model that adjusted the cost of a new plant for the age and other factors would have been an important check of the sophisticated deterministic or stochastic models.

Chapter 4: The Structure of Alternative Financial Models: Common Features and Differences in Layout of Financial Models for Project Finance, Corporate Finance and Merger and Acquisition Analysis

In developing any deterministic financial model, before you begin to enter data or write any excel formulas or make any valuations, it is essential to think about the architecture of a model. This idea of coming up with the structure virtually any analysis in finance, economics or for that matter science and engineering involves (1) organizing the inputs, (2) understanding mathematical calculations and (3) presenting outputs. The general design of a financial model involves deciding on how to organize the inputs from various information sources in an structured manner; how to formulate the mechanical calculations in a transparent way that is easy to audit and understand; and, finally how to present the outputs so that

[3] 2001 FPL SEC 10-K.
[4] 2001 FPL SEC 10-K, the official reason given by FPL for the write-off was a change in regulations regarding transmission pricing.

purposes of risk assessment and valuation. Other than these basic elements of structuring the inputs, calculations and outputs of a model, subjects that should be considered in laying out the architecture of a model are the programming of time periods, the methods for verifying model accuracy and the setting-up of alternative scenarios. Much of the process in developing an effective model is simply putting things in an order that makes sense and understanding the starting point of the model.

One of the most influential and lasting ideas in finance has been the work of Modigliani and Miller in 1958 who suggested that the focus of valuation should be on aggregate free cash flow that can be distributed to debt, equity any other investors rather than the way the cash flow is split up between alternative investors. If you really still believe the theory developed by Modigliani and Miller that debt and other forms of financing does not make any difference in the way real world investments are made, or that debt does not influence valuation, then you should then stop all of your financial models after computing EBITDA, capital expenditures, working capital changes and taxes on operating earnings (EBITDA, capital expenditures and working capital changes are the components of the typical definition of free cash flow). There is no need to worry much about the financial structure of a model and create an income statement or compute earnings per share, equity cash flow, debt service coverage or a balance sheet. You can only focus on operating cash flow less taxes that must be paid before any money is paid to investors; capital expenditures that must be made to sustain operations; and, working capital changes adjust EBITDA to reflect true cash flow. Although calculating prices, demand, cost structure and the cost of new capital equipment – the drivers of unleveraged free cash flow -- is the most important aspect of any model, almost all of the valuation techniques described later in the book require analysis of items in addition to free cash flow. When financing is explicitly considered, models may concentrate on earnings after interest and/or debt and equity cash flows (after debt service) and/or financial ratios such as Debt/EBITDA that include balance sheet items. Therefore, much of the discussion of financial models in this chapter considers the financial structure of a company or project and the distribution of free cash flow to debt investors, equity investors and income taxes.

The layout and ordering of items in a deterministic financial model to a large extent depends on the type of investment being assessed. Most financial models can be classified into five general categories -- corporate models, project finance models, acquisition models, merger integration and real estate models. Because of different data sources and alternative valuation techniques, the layout of financial models is different for each of these model types. The valuation techniques, data sources and outputs of these models can be summarized as follows:

Corporate Model: The distinguishing feature of the first and most common model type, a corporate model, is that a corporation has a history and it is assumed to last indefinitely (although virtually all companies will either end up in bankruptcy or eventually be purchased.) This means that valuation of a corporation begins with historic analysis and the models must include some kind of terminal value assumption. The terminal value calculation is necessary because it is not reasonable to make detailed forecasts of cash flow item for the indefinite life of the corporation which would require forecasts for fifteen to fifty years into the future. An important item in corporate models is the projection of earnings per share since this is the number evaluated by investment analysts.

Project Finance Model: The second type of model for a project finance transaction differs from a standard corporate model because the investment is characterized by different phases with different risks; the fact that no history on cash flows exists for the investment (no matter how many times a similar new combined cycle plant is built, you don't know how it will work until you switch it on); and the isolation and quantification of particular risks. Rather than spending time on studying history, project finance analysis involves evaluating consulting studies and engineering reports such as traffic studies, price forecasts and marketing analyses. The project finance models focus on cash flows accruing equity holders and lenders rather than earnings and the projections generally cover the entire defined lifetime of the project.

Acquisition Model: The third type of model, an acquisition or leveraged buyout model, measures the returns earned from an acquisition transaction that involves the consideration paid for the equity of the company, the holding period of the investment and exit price as well as the manner in which the acquisition is financed. To compute equity returns, acquisition models measure the manner in which alternative financing sources are repaid and ultimately compute the return earned by equity investors.

Merger Model: An integrated consolidation model computes earnings per share and credit quality measures on a standalone and a consolidated basis before and after a merger or acquisition. This type of model considers the specific financing and accounting of the transaction as well as cost savings or synergies generated by the transaction. A common application of this type of model is to evaluate how much can be paid for a company before earnings dilution will occur and bond ratings can be maintained.

Real Estate Model: A real estate model is a cousin of project finance models but also has many elements of corporate finance analysis. Rather than concentrating on a single investment, a group of multiple investments in a portfolio are often combined together. For example, a mixed development model includes different residential properties with different construction start and finish dates as well as different commercial and even industrial properties. Real estate models must be able to evaluate cash flows that are produced at different time periods without a single construction and operation period. Further the models must be able to quantify the effects of different holding period strategies and alternative tax treatments. Appendix 1 discusses the real estate models in more detail.

Each of the different model types has many principles and programming techniques in common. They each require up front thought as to the structure and the scope of the model; they each require analysis of timing issues; they each should be segregated into components and begin with layout of operating and financing assumptions; they each should each have audit and verification procedures; they each should have a starting point; they each should not contain bad programming practices; and they each should be structured so as to facilitate effective risk analysis. However, each model structure contains unique complexities that can make the models difficult to understand, in-flexible, in-accurate, unorganized and un-stable. Differences between the structures of alternative model types are discussed below.

Structure of a Corporate Model to Recount the History of the Company and Make Forecasts that Include Sensible Outlooks of Key Drivers

Among other things, forecasts from corporate models are used to compute free for making valuations and to assess the credit quality of a company in the context of providing loans. Valuation from corporate models may use discounted free cash flow, evaluate earnings per share or it could be derived from equity cash flow. Loans may be assessed in a corporate model through gauging the ability to repay debt service from cash flow and/or evaluating the capability of the corporation to repay the loans through re-financing given a set of credit quality indicators such as debt to equity and debt to cash flow ratios.

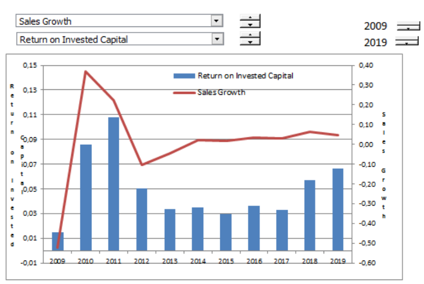
The structure of a corporate model is directly associated with the idea that a company has a history and an indefinite lifetime (unlike a project finance investment that generally has no historic record and will end once the asset is no longer useful). Whereas a project is analogous to a person's life or to a relationship -- both of which have a definite end -- a corporation is more analogous to an entire country or city which may have seen better times or may have bright future prospects. The indefinite life of a corporation means that a financial model can only take a snap shot of the company that covers a portion of its history and also that the forecast must stop at some point while the company is still generating cash flows. It is usually impracticable to include all periods of history in the model and it would be silly to try to make a forecast that extents infinitely. But including enough history in a model so that you can make judgments

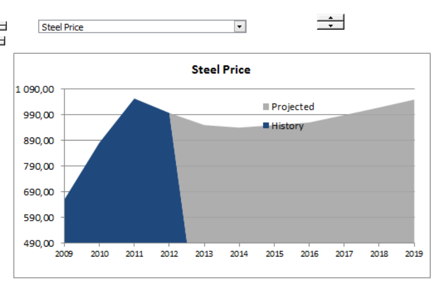
about exposures to economic downturns and potential volatility in cash flow is an essential part of making a corporate model. When Winston Churchill observed: "The farther backward you can look, the farther forward you can see" he surely was not talking about the structure of a corporate financial model, but the quote is relevant to the structure of a corporate model. Perhaps the most prominent feature that differentiates corporate models from project finance models is incorporation of historic data and the ability to analyse both projected results alongside historic data.

Designing the structure of a model should follow a logical and natural progression beginning with history, moving to assumptions, computing operating cash flows and then adding debt financing. When setting up a corporate model, the structure should allow users of the model to easily make judgments with respect to whether assumptions are reasonable in the context of historical performance. As part of the historic evaluation, it is a good idea to present historic together with projected financial ratios such as return on invested capital, EBITDA margin and credit ratios in order to tell a story about what has happened to the company in the past and what you expect to happen in the future. By presenting financial ratios such as return on investment next to the key assumptions, you and others can quickly see if you made some nonsensical assumptions and your model is less of a black box. In addition to recounting a tale about what happened in the past, analysis of financial ratios provides a basis for comparing projections with actual results that can be used as a simple check on the reasonableness of a forecast. If the return on investment has consistently hovered between 8% and 10% and your forecast shows a return of 20% you better have a very good and simple explanation about what kind of special thing the company is going to do to earn the higher return.

To illustrate how corporate finance analysis is centred on analysis of history and should be a narrative about the company, the excerpt below from the summary page of a corporate model shows how graphs of historic data is connected to assumptions and how the valuation is most effective when it is judged in light of historic and projected financial ratios. There is one graph that shows a couple of financial ratios together (in this case it shows sales growth and return investment corresponding to the fundamental idea of corporate finance theory that when returns exceed the cost of capital, it is good for investors to grow a company). A second graph shows the history and forecast for one of the key assumptions. The drop down boxes allow you to see a wide range of assumptions combined with alternative financial ratios. These graphs provide a context to evaluate the valuation summary shown on the bottom left hand side of the excerpt. Finally, the model should allow for flexible evaluation of a host of alternative assumptions shown in the top left hand side of the picture below.

Overall Scenario	Base Case	
Discretionary Capital Expenditures	300	
Dividend Payout	50%	
Custom Scenario: Production	Base Production	3,00%
Custom Scenario: Price	Base Price Case	820,00
Maintenance Cap Exp	Base Case Mainte	
Variable Cost of Revenue	62,00%	
Fixed Cost of Revenue	4%	
Selling Costs	5,85%	
Interest Rate	8,50%	
Valuation Year	2014	
Terminal Year	2020	
WACC	10%	
Terminal Growth	2%	
Terminal EV/EBITDA	8	



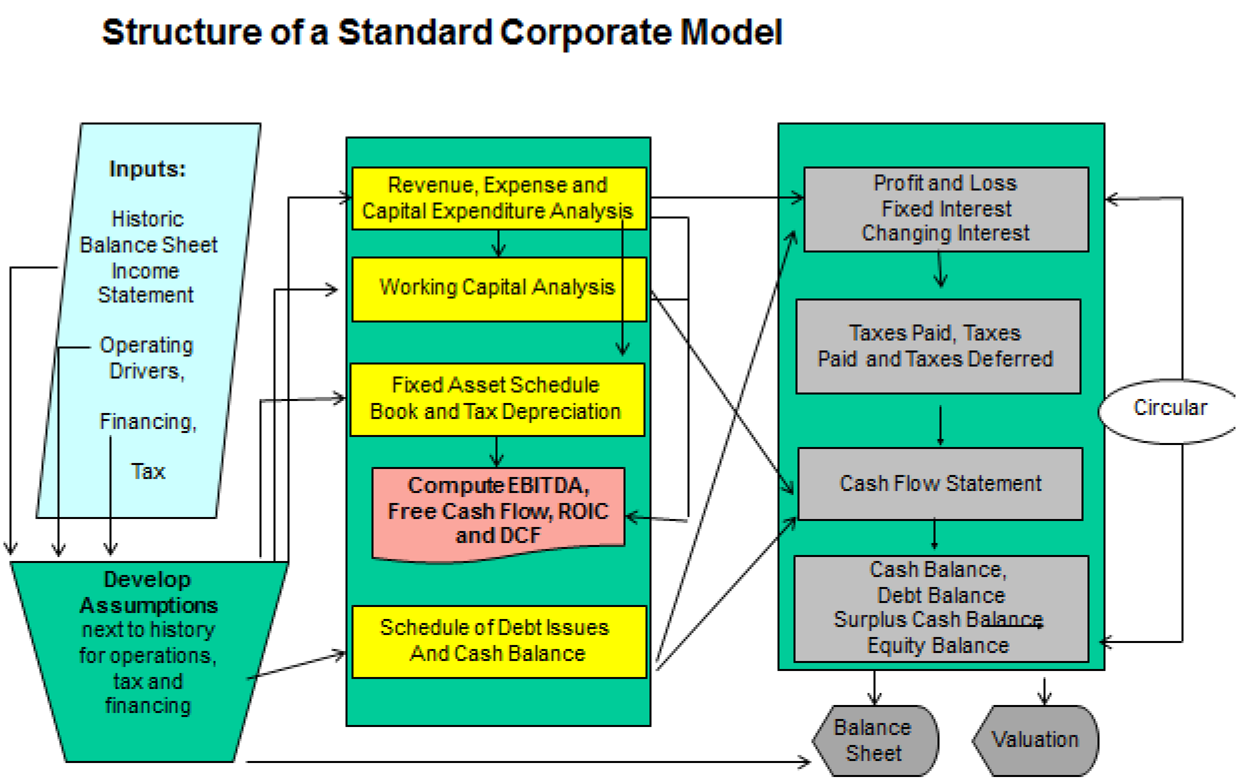


	Stable Growth	EV/EBITDA Ratio	Value Driver
PV of Explicit Cash Flow	4 628,07	4 628,07	4 628,07
Add: Terminal Value	12 233,37	13 459,27	6 418,65
Total Enterprise Value	16 861,44	18 087,34	11 046,72
Less: Bridge	5 022,72	5 022,72	5 022,72
Total Equity Value	11 838,72	13 064,62	6 024,00
Shares	1 339,13	1 339,13	1 339,13
Value per Share	**8,84**	**9,76**	**4,50**

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
EBITDA	2 594,00	4 305,00	6 323,00	1 237,00	2 350,00	2 898,00	2 012,00	1 807,49	1 910,51	1 917,78	2 081,98
Funds from Operations	1 997,00	4 380,00	4 378,33	1 584,00	1 742,00	2 769,00	2 453,00	2 048,48	1 921,33	1 928,20	2 082,10
Less: Capital Expenditures	651,00	744,00	1 103,00	441,00	832,00	1 281,00	1 261,00	1 050,00	1 065,00	1 080,30	1 095,91
Cash Flow Before Financing	1 346,00	3 636,00	3 275,33	1 143,00	910,00	1 488,00	1 192,00	998,48	856,33	847,90	986,19
Less: Debt Service	256,00	450,00	712,00	717,00	741,00	725,00	668,00	2 402,07	1 541,80	1 889,71	2 288,03
Cash Flow Before Dividends	1 144,00	3 268,00	2 677,33	506,00	195,00	797,00	570,00	(1 339,30)	(661,36)	(1 020,26)	(1 279,85)
Less: Dividends	-	1 449,50	1 171,03	0,14	-	465,74	-	-	2,23	-	29,81
Net Cash Flow	1 144,00	1 818,50	1 506,30	505,86	195,00	331,26	570,00	(1 339,30)	(663,59)	(1 020,26)	(1 309,66)

Corporate models should have a natural progression of assumption development and working analysis from the income statement and the balance sheet. The beginning of a corporate model is painting a

picture of the company using historic financial statement analysis. Next, a corporate model involves defining how one incorporates history as well as prospective industry structure and economic assumptions to assess the value of a business. In arranging assumptions as well as the calculations section of the model, the order should begin with revenues, expenses and capital expenditures followed by working capital, taxes and depreciation and ending with financial items. The separation of assumptions and calculations into pre-tax cash flow (revenues, expenses, capital expenditures and working capital), after tax free cash flow (pre-tax cash flow less taxes on operations after considering depreciation and amortisation) and financing is common to the structure of all different model types. For the working capital section, the depreciation section, liabilities section and net debt section of a model, two very simple ideas can dramatically improve the structure of the model. The first is understanding that the starting point for all of the fixed asset accounts, debt accounts, working capital accounts, deferred tax accounts, accumulated depreciation accounts, surplus cash accounts, and other items come straight from historic balance sheets. The second is setting up separate accounts for all of these items where historic closing balances come from the historic balance sheet and projected amounts are often directly or indirectly derived from capital expenditure, revenue and expense forecasts. For example, capital expenditures are added to the opening plant balance (and retirements can be deducted from the balance) to yield the closing balance for the next period. As shown in the diagram below, after making a forecast of after-tax free cash flow, the challenge is to connect interest expense and interest income in the income statement to the balance sheet debt through evaluating the cash flow.



The diagram above is intended to illustrate some of the important points in structuring a corporate model. The process begins with analysis of history and the using historic balance sheets to set-up accounts. The working analysis, the fixed asset balance and the debt schedule are the essential intermediate steps that should be completed before constructing financial statements. Developing revenues, operating expenses and capital expenditures in the working sheets is just about always the most important part of the analysis. When making forecasts of revenues, expenses and capital expenditures it is generally a good idea to graph history and projections of key variables that drive these three things such as prices, market

share, industry demand growth, capacity utilization, variable costs and capital expenditures per unit. Once the operating analysis, depreciation, and debt analysis are complete, financial statements can be constructed. As most of the components of financial statements such as revenues, depreciation and interest expenses have already been in separately structured sections, this part of the analysis should be quite simple.

One of the main computational challenges in a corporate model is to determine how surplus or deficit cash should be deployed and to develop projections of depreciation and deferred taxes that account for the lifetime of different asset classes. The diagram above illustrates that connection of the profit and loss statement with the interest expense and interest income that is a typical characteristic of a corporate model (that can create circularity). The arrow on the right hand side of the diagram is meant to show that interest expense on new debt calculated from the model is not known until the debt balance is computed from the cash flow and interest income on surplus cash is not known until the amount of surplus cash is derived. Unlike project finance models, dividends are determined from an algorithm such as a payout ratio and are not the result of the cash flow process.

The final parts of the diagram show that the balance sheet should be an output of the model rather than part of the mechanical calculations. To construct a projected balance sheet, the common equity balance can be calculated using historic balance sheet data and projections of net income and dividends as with the other balance sheet accounts where an opening balance and changes are included (a similar account can be computed for minority interest.) With all of the accounts completed including the equity balance, the balance sheet can be computed by simply gathering together the closing balance of all of the accounts. Then you can be so very happy to see that your balance sheet is in balance for every single period of the model. Much of the remainder of this chapter is structured to work through each part of the model shown in the diagram above: there is a separate section devoted to discussing economic, financial and modelling issues associated with the input section; the operating or working section; the debt schedule; the profit and loss statement and the cash flow statement.

Some of the computational challenges in corporate models include:

- Development of effective assumptions that include industry supply and demand and conversion of capacity, demand and market share into revenues, expenses and capital expenditures;
- Flexible incorporation of historical financial data to accept updates when new financial data become available;
- Modelling projected depreciation expense with asset retirements, deferred taxes and net operating losses;
- Including target capital structures in the models rather than assuming net cash flow builds up cash balances or accumulates debt; and,
- Dealing with unfunded pensions, derivative assets and liabilities, stock options, intangible assets and other items.

Graphing Data with the Windows Wiper Method

This book is structured by first discussing conceptual issues associated with financial and economic modelling and then presenting practical methods to implement the

Use of the INDEX function

Creating forms (spinners, dropdown boxes, slider boxes and check boxes). Must show the developer ribbon and use the format control. Then the wiper to method to make sure the form works in any sheet.
Can use with F11 key to make a graph of a long list of data. Combine the dropdown with the spinner for the graph and use the INDEX function.

Making the Painful Process of Acquiring Data from a PDF File Easier

When making forecasts in the 1980's you had to ring the company and ask for the annual reports to be sent after which you had to manually type in all of the data. Life is better now but certainly not perfect. You can directly download data from free websites or you can pay a lot of money to Bloomberg for the data but invariably you still need to use some data from the annual report of a company that is not in a nicely structured spreadsheet but instead part of a pdf file. Copying data from a pdf file into excel results in a mess where words are in different cells and numbers are not in consistent columns (sometimes the items are not in different cells which means you should use the text to columns option in the data menu). The data may look something like the format below:

Notes	2008	2007	2006										
ASSETS													
Non-curre	assets												
Property,	plant	and	equipmer	9,00	$	9,01	$	10,11	$	3,66			
Intangible	assets	other	than	goodwill	10,00	885,00	806,00	37,00					
Goodwill	5,00	2,39	2,15	112,00									
Investmer	in	joint	ventures	and	associates	11,00	551,00	592,00	1,49				
Deferred	income	tax	assets	8,00	44,00	22,00	11,00						
Other	non-curre	assets	13,00	278,00	240,00	272,00							
13,16	13,91	5,58											
Current	assets												
Inventorie	14,00	2,42	1,62	864,00									
Trade	and	other	receivable	15,00	1,37	1,80	556,00						
Prepayme	76,00	196,00	82,00										
Loans	receivable	108,00	48,00	19,00									
Receivabl	from	related	parties	16,00	137,00	60,00	54,00						
Income	tax	receivable	262,00	86,00	51,00								
Other	taxes	recoverab	17,00	397,00	351,00	331,00							
Short-terr	investmer	18,00	589,00	25,00	25,00								
Cash	and	cash	equivalen	19,00	930,00	327,00	842,00						
6,28	4,51	2,82											
Assets	of	disposal	groups	classifi	ed	as	held	for	sale	12,00	7,00	211,00	105,00
6,29	4,73	2,93											
Total	assets	$	19,45	$	18,64	$	8,51						

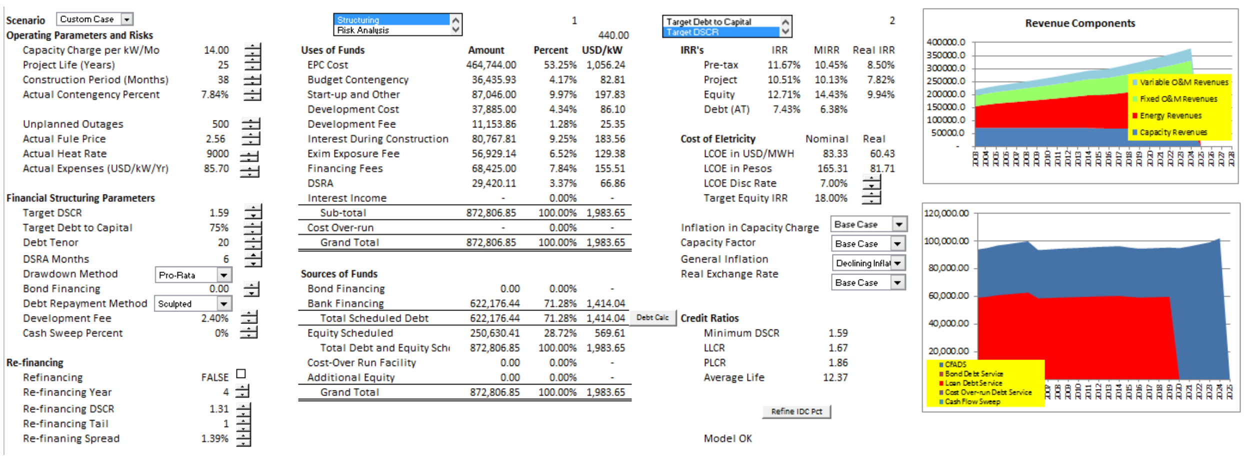
To format the data you can create a macro to move numbers into a consistent column and then use a function to sum the text into a single cell. Once you run the function and the macro the format is cleaned up as shown below:

		2008	2007	2006
ASSETS				
Non-current assets				
Property, plant and equipment 9		9,012	10,107	3,655
Intangible assets other than goodwill 10		885	806	37
Goodwill 5		2,387	2,145	112
Investments in joint ventures and associates 11		551	592	1,494
Deferred income tax assets 8		44	22	11
Other non-current assets 13		278	240	272
		13,157	13,912	5,581
Current assets				
Inventories 14		2,416	1,619	864
Trade and other receivables 15		1,369	1,802	556
Prepayments		76	196	82
Loans receivable		108	48	19
Receivables from related parties 16		137	60	54
Income tax receivable		262	86	51
Other taxes recoverable 17		397	351	331
Short-term investments 18		589	25	25
Cash and cash equivalents 19		930	327	842
		6,284	4,514	2,824
Assets of disposal groups classifi ed as held for sale 12		7	211	105
		6,291	4,725	2,929
Total assets		19,448	18,637	8,51

Writing the macro and the function only require a few lines of code using two fundamental concepts. The first is a FOR and NEXT loop and the second is the CELLS command. In the next few chapters these concepts are described in detail and an explanation of the code is included appendix to this chapter.

Structure of a Project Finance Model that Accounts for Different Financing, Risks and Accounting in Different Phases over the Life of a Project

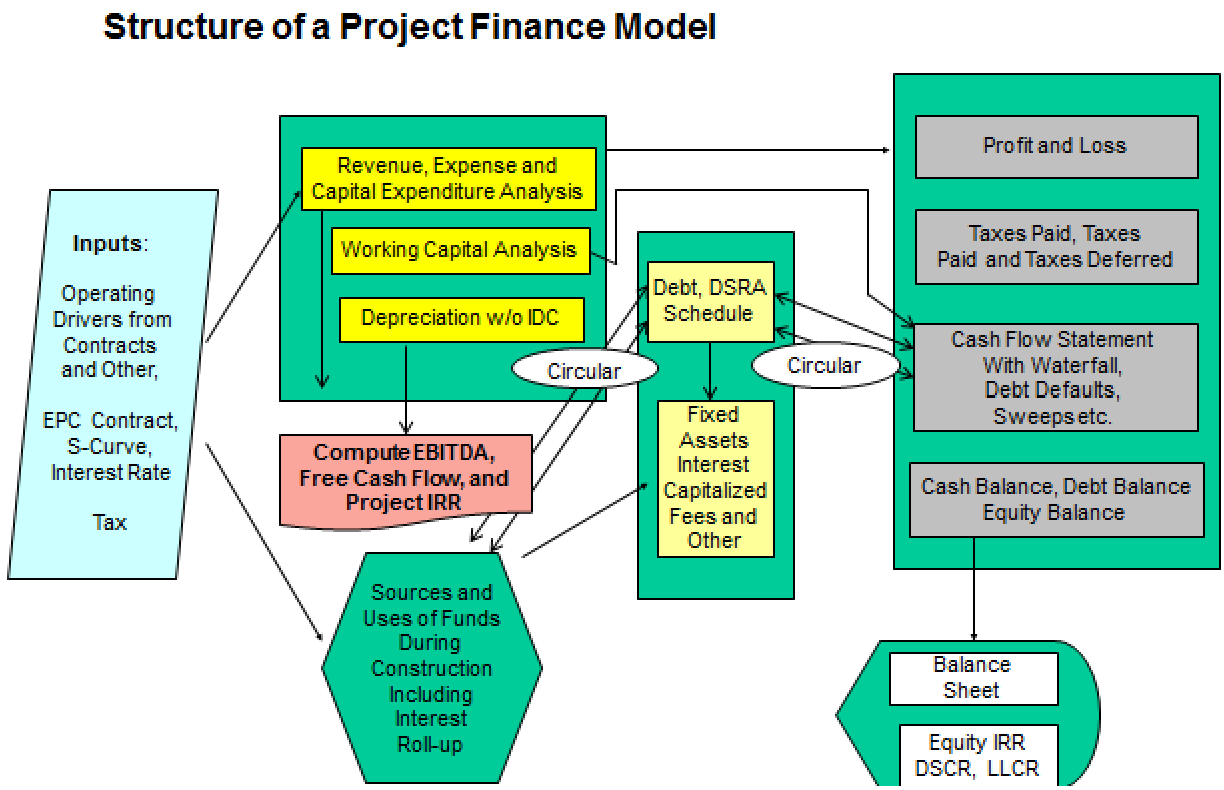
Unlike corporate models, project finance models do not begin with historic data, but rather must evaluate risks and returns for different phases in the defined lifetime of a project. Most key financial outputs from project finance model come directly from the cash flow statement rather than the profit and loss statement (including the equity IRR and the ability of cash flows to cover debt service in each period which or the debt service coverage ratio). Project finance models can have for two distinct objectives. The first is to structure the debt and equity that will be issued in the transaction including the size of the debt, the tenor of the debt and the manner in which debt will be repaid. The second is to assess specific risks in different time periods of the project life given the defined financial structure. Unlike corporate models, the information base for project finance models is a series of contracts, construction budgets, consulting reports and possibly projected commodity prices and variable sales quantities. Given that there is no historical record for a project finance corporation called a special purpose vehicle (SPV) and therefore no historic balance sheet, the launching point for projection of financial statements is construction of a sources and uses of funds during the construction phase of a project. An example of outputs from a project finance model is shown in the diagram below. Key drivers of the project such as the capital cost per unit of output, the product price and the utilization are shown together with the IRR and various different ways to measure the debt service coverage.



The general structure of a project finance model is illustrated on the diagram below (a more detailed structure is described in the last part of the chapter.) One of the essential elements of a project finance model is that different calculations are made for distinct phases of the project – the development phase, the construction phase, the operation phase, the debt repayment phase and possibly a re-financing phase. The sources and uses statement is computed during the development and the construction phase. While the things that go into this part of the model are not complicated to think about – what ones spends money on and how one raises the money – the source and use statement provides a good picture of what the project is about (recall Eurotunnel from Chapter 1). From a mechanical perspective, the sources and uses statement replaces the balance sheet as the starting point for the balance sheet accounts. This is illustrated in the diagram where arrows from the source and use statement launch the fixed asset schedule and the debt schedule. The working module that computes revenues and expenses is similar to the corporate model as is the fixed asset schedule and the debt schedule. Part of the debt schedule is computing the interest during construction that is capitalized to the cost of the plant.

A project finance model can involve complex programming issues regarding (1) setting-up time periods; (2) working out a funding cascade for senior debt, subordinated debt, and equity during construction; (3) modelling the debt service reserve account and the maintenance reserve account; (4) developing a cash flow waterfall that works through cash flow priorities; (5) sculpting debt repayments to meet a debt service coverage constraint, modelling depreciation that depends on calendar years; and, (6) re-financing debt

and incorporating cash sweep covenants. The difficult challenge in creating a project finance model is to address these issues without making the model hopelessly complex and cumbersome with many macros and complicated formulas. A separate section at the end of the chapter addresses programming issues to resolve these issues in a painless manner as possible.

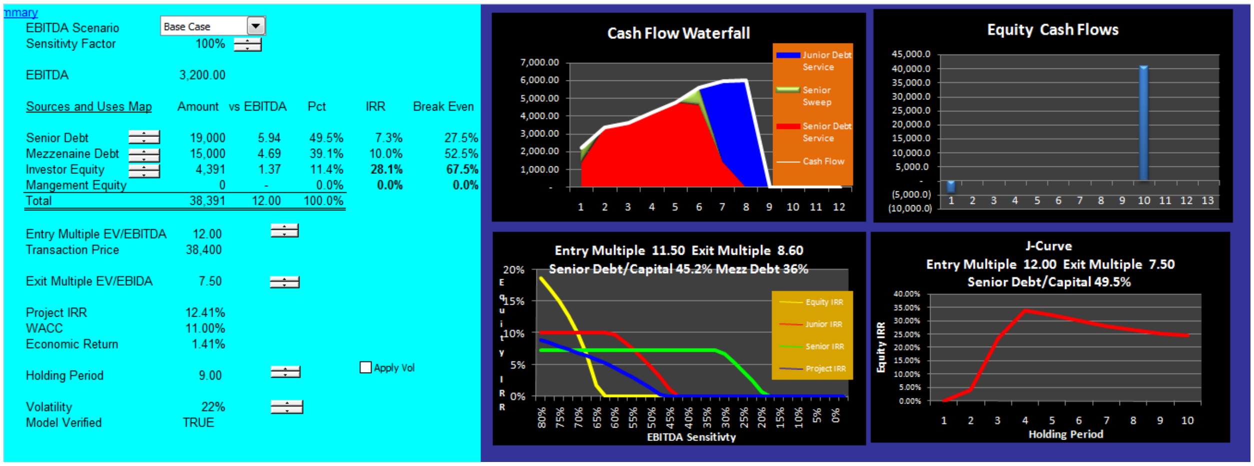


Since a project is generally a one-off investment where debt and equity investors focus on cash flow rather than accounting earnings, the structure for computing cash flow is also different in a project finance model then in a standard corporate model. For a project finance model, the final part of the cash flow waterfall is the dividends paid to the owners of the SPV (sponsors) meaning that dividends are not defined by a dividend payout, dividend per share or some other algorithm, but rather are the residual cash flow not paid or reserved elsewhere. As illustrated in the diagram below, effective modelling of cash flows involves integration of the debt schedule with the cash flow waterfall in the cash flow analysis as well as launching the model from a sources and uses of funds analysis. Risk analysis of a project finance model is also different phases as the construction period typically involves technical risks and the operation period includes economic risks. Finally, as with the corporate model, the balance sheet is part of the output in which all of the accounts such as plant balance, debt service reserves, senior debt balance, subordinated debt balance and common equity balance are already defined.

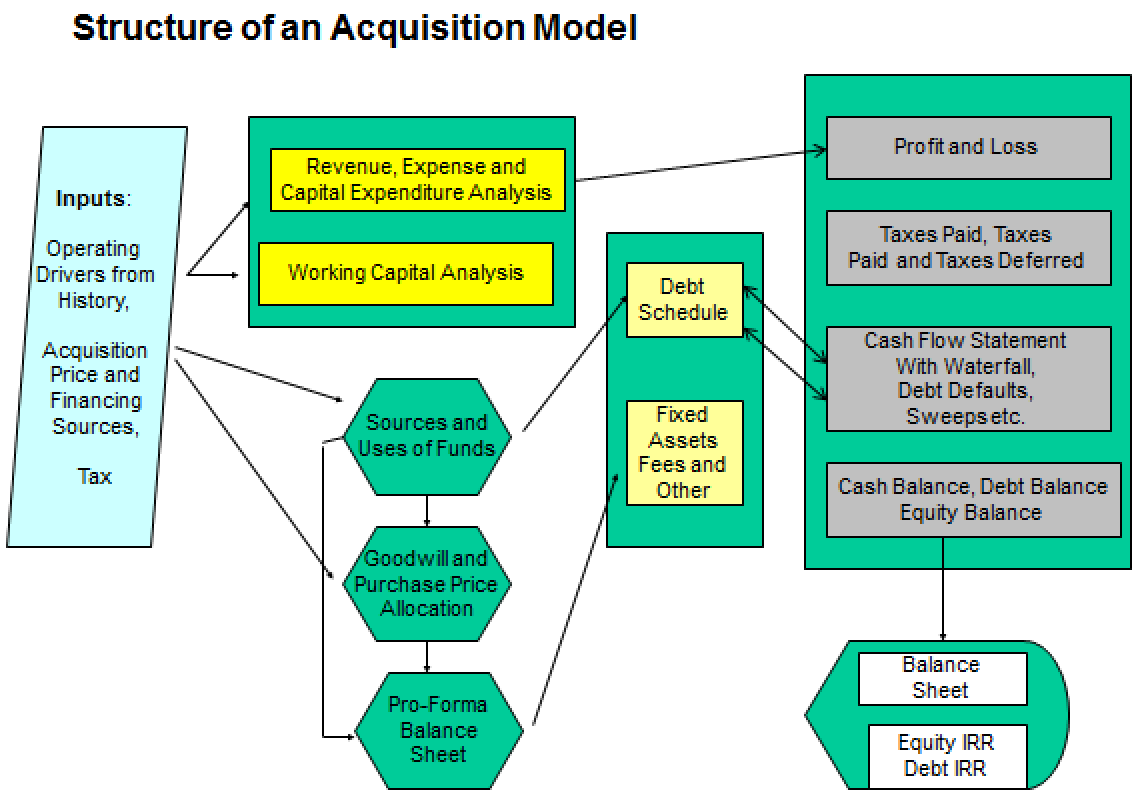
Structure of an Acquisition Model that Reflects Alternative Transaction Prices and Debt Terms and Evaluates the Return and Risk to Different Providers of Capital

An acquisition model is typically developed to determine how much to pay for a target company and how much of the purchase price can be financed with different types of financing including amortizing debt, debt with a bullet maturity and debt with capitalizing interest (this is sometime known as "ABC.") Key assumptions in an acquisition model include how much the operating cash flow can grow with new owners and a new strategy as well as the how much the company can be sold for after the holding period. Financial ratios used in assessing an acquisition are often related to the EBITDA. These include the

enterprise value (net debt plus equity value) to the EBITDA; the senior debt level to the EBITDA; and the total debt level to the EBITDA. As with a project finance model, an acquisition model can be used for both structuring the amounts of different type of debt as well as risk assessment. The figure below illustrates output from an acquisition model that could include an illustration of how cash is distributed, break-even points and a J-Curve that illustrates optimal holding periods and equity cash flows that drive the equity IRR.



The structure of an acquisition model is illustrated in the diagram below. The diagram illustrates that modelling a leveraged acquisition transaction involves combining some aspects of corporate models and other aspects of project finance models. As with a corporate model, the history of the company is a starting point for painting a picture of the company. However, as with a project finance model, equations in an acquisition model should begin with a sources and uses analysis that shows how much cash is used for the transaction and where the cash comes from. After the sources and uses map is established, a goodwill analysis should be added that allows construction of a pro-forma balance sheet. The general structure of computing a pro-forma balance sheet through mapping the sources and uses of funds along with a goodwill analysis that incorporates the accounting aspects of the transaction is shown in the second column of the diagram. Once the pro-forma balance sheet is created, the modelling process contains similarities to both a corporate model and a project finance model. As with a corporate model that works through different asset and liability accounts on the balance sheet, an acquisition model works through accounts where the first year closing balance comes from the pro-forma balance sheet. As with a project finance model, defining phases in an acquisition model is an important part of the process –the transaction period should be distinguished from the holding period and the terminal period. The right hand side of the diagram below shows that the cash flow modelling process is analogous to the methods described for a project finance model where a waterfall progression measures the priority of cash flows to the various sources of funds and ultimately the equity holders.



Some of the challenges in creating models that measure the value of an acquisition or a leveraged buyout include:

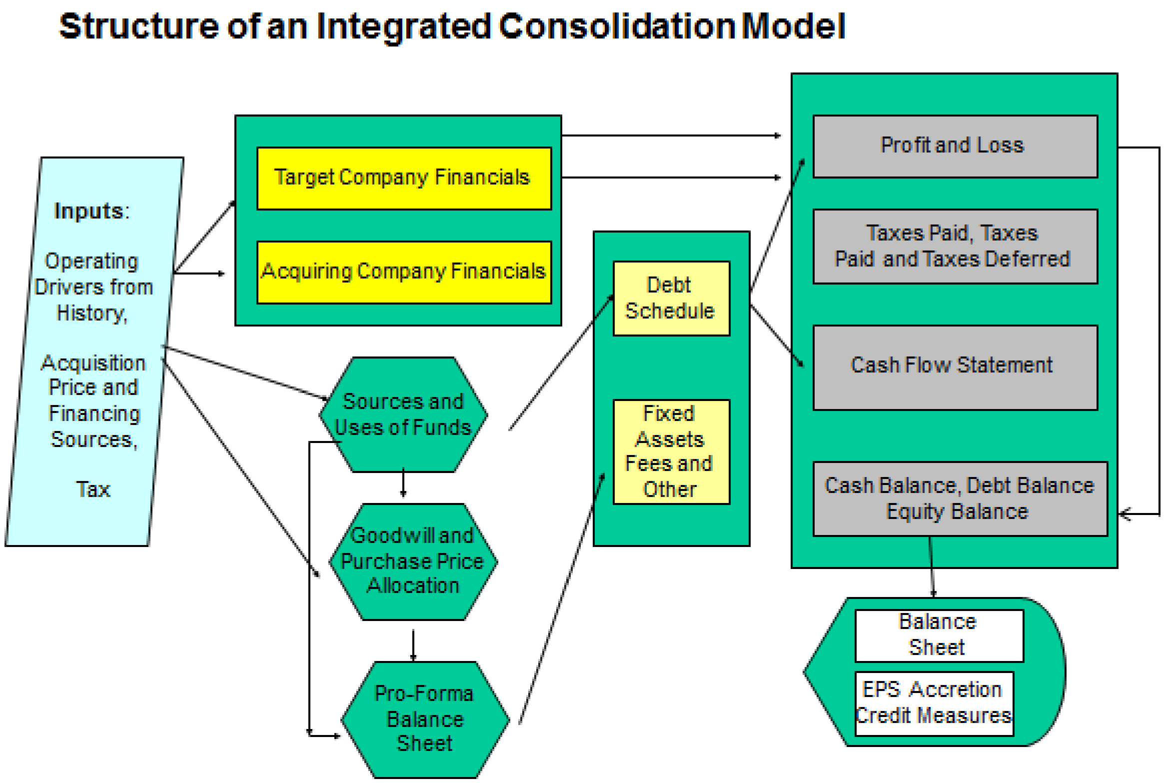
- Creating a cash flow waterfall with alternative amortizing, bullet and capitalizing debt as well as cash requirements and revolving debt facilities
- Developing a alterative structuring assumptions and a pro-forma balance sheet
- Modelling income taxes and alternative tax treatments of transactions
- Simulating the structure of equity cash flows to alternative investors from earn out provisions and equity kickers

Structure of an Integrated Merger Model that Produces Forecasts of Earnings Per Share Given Different Transaction Structures and Synergy Estimates

The objective of a merger integration model is to evaluate how much to pay for a company and how to structure the financing of a merger transaction. An integrated merger model compares earnings per share and credit statistics in the case where a merger takes place to a scenario without a merger. The prospective earnings of the merged company depend on how much is paid for the acquisition and how many synergies are generated from changing management as well as the financing of the transaction. When measuring the cost and benefits of a merger using an integrated model, the information base is the historic operations, projected cost savings and/or revenue increases and transaction terms.

The diagram below demonstrates that an integrated model structure mixes elements of an acquisition model and a standard corporate model. As with the leveraged acquisition model, the starting point of a merger integration model is a source and use analysis of the transaction and the pro-forma balance sheet after goodwill and other adjustments. The only difference is that the pro-forma balance sheet begins with existing balance sheets of both the target company and the acquiring company. For an integration model, the transaction assumptions incorporated in the sources and uses analysis may include a share

exchange, multiple debt issues and new equity offerings. Once the starting balance sheet established, the remaining calculations of the cash flow process are similar to the corporate model where computation of net cash flow leads to the accumulation of a net cash balance and the net cash balance is separated between short-term debt and surplus cash liquid investments. The debt schedule includes issues retired in the transaction (shown in the sources and uses analysis) and new issues to finance the merger as well as the associated fees and breakage costs. Shares issued in the transaction could come from offering new shares or from the shares issued to target company shareholders as part of a share exchange transaction. The diagram shows that instead of computing a working analysis to derive revenues, expenses and capital expenditures these numbers come from individual corporate models for the target company and the acquiring company. The most difficult item to project is the synergies that arise from management changes that occur with the transaction. In the real world, these synergy projections must be made with only public information and no time.



A comparison of the elements that are included in the layout of different types of financial models is shown in the table below.

	Project Finance	Corporate Model	LBO Model	M&A Integration Model
Information Base	Contracts and analysis of Commodity Prices and other value drivers	Historical financial statements; Analysis of value drivers	Historical financial statements; Analysis of value drivers; Transaciton Terms	Historical financial statements; Analysis of value drivers; Transaciton Terms
Model Starting Point	Sources and Uses Analysis	Historic Balance Sheet	Sources and Uses and Pro-Forma Balance Sheet	Sources and Uses and Pro-Forma Balance Sheet
Cash Flow Process	Cash flow waterfall that ultimately measures dividends paid to equity	Net cash flow after dividends that result in changes in short-term debt or surplus cash	Cash flow waterfall that ends in dividends paid to equity	Cash flow changes that result in changes in short-term debt or surplus cash
Debt Analysis	New Debt Issues from Transaction	New and Existing	New Debt Issues from Transaction	Existing Debt Issues; Retired Debt Issues; New Debt Issues
Model Termination	End of project life	Arbitrary terminal period	Transaction holding period	EPS analysis period
Model Complexities	NOL; cash traps and sweeps; construction period issues; debt service reserves; debt sculpting	NOL; target capital structures; circularity; depreication vintage	NOL; cash sweeps; interest capitalization on sub debt; debt service reserves; terminal period	Pro-forma balance sheet; minority interest changes; new debt issues
Model Output	Equity IRR; Project IRR; DSCR	DCF Valuation; EPS projection; Implied P/E; Credit Quality	Equity and Debt IRRs; Debt/EBITDA	Project EPS and Other Ratios on Standalone vs Combined Basis

Subsequent sections of this chapter discuss issues in creating each of the major model components. In addition to the general description of what should be included in each section, a discussion of some practical programming tips for those who are involved in construction of models on a regular basis.

Chapter 5: Avoiding Bad Programming Practices and Creating Effective Auditing Processes for Model Verification without Following Unnecessary and Bureaucratic Best Practise Rules

For purposes of valuation and investment analysis, models do not have to be overly complex with numerous different spreadsheets and tedious detail for items that are relatively insignificant. Most people's reaction to receiving a model with thirty different sheets and excruciating detail of operating expenses is to put the model in a drawer and to not perform risk analysis with the model. Even if valuation models are relatively simple, creating a model that is flexible enough to handle different risks; that accurately measures cash flows; that present the key value drivers and important outputs in an easily understandable and transparent manner; and that does not crash excel because of circular references often requires a disciplined approach to excel programming. A well structured model can avoid the ghastly feeling of, after completing a model, being asked by a supervisor to open and revise a model that was created a few weeks earlier. This feeling often comes from knowing that you will have to review a long and complex formula with multiple "IF" statements that can no longer be interpreted. These types of formulas are generally incomprehensible without completely re-constructing the formula and splitting it up into many different rows.

Some companies require use of a set of "best practices" for programming models. While these practices may help in making models transparent and effective in presenting valuation issues, you can become obsessed with the programming practices and lose sight of the ultimate objective of a model. For example, in order to keep formulas the same across excel columns for the transaction period and subsequent periods, complicated IF statements may be developed that are difficult to interpret. Instead of suggesting there is such a thing as best practice, it is easier to make a list of bad practices that should avoided. Through avoiding the following practices a model easier to interpret and modify are presented below:

- ❖ There should be no inputs in any part of the model other than the input page. One of the worst and most obvious problems is to include inputs as part of a formula (e.g.A11*5); these partial inputs are difficult to find and make the models inflexible.

- ❖ Keep formulas in the model as simple as possible and clearly delineate how each formula is derived from the inputs (this is often a problem with long "if" statements). Long formulas can be avoided by splitting formulas into multiple different rows and by using TRUE/FALSE switches. Do not use nested IF statements. Ever. This does not mean that you should follow the sill rule of thumb were formulas are not longer than your thumb (unless you have a very long thumb).

- ❖ Make sure that spreadsheet columns are consistent throughout the model and that the formulas for each column are identical (with the possible exception of the very first period in corporate models and acquisition models.)

- ❖ Include the units (such as tons or thousands of Euros) for each column of the inputs and the working sheet.

- ❖ Carefully specify the time period of the model using time period codes that define alternative phases of the analysis. Use the LOOKUP function rather than the VLOOKUP or HLOOKUP function to associate inputs with the time period.

- ❖ Divide the model into separate modules, beginning with input modules and make the inputs a separate colour (the word module simply refers to a separate part of the model -- it could be a separate spreadsheet page or simply a segment of one sheet.) When entering inputs in one or more modules, operating inputs should be separated from financial inputs.

- ❖ Make calculations of operating cash flows in a separate module to measure how the value drivers result in operating revenues, operating expenses and capital expenditures in a working analysis. This means that elaborate revenue or expense calculations should not be directly in financial statements. The calculations in the working sheet should be as transparent as possible through listing inputs and using a lot of rows to show all of the factors that are used in making various computations.

- ❖ Include separate modules for debt issues, fixed plant assets, working capital and cash balances. The debt module should include the interest rates, interest expenses, repayment mechanics, pre-payment possibilities, financing fees and potential for default. The fixed plant asset schedule should include calculation of book and tax depreciation.

- ❖ Work through every single balance sheet item showing the opening balance, additions and subtractions from the account and the closing balance for each the accounts. This analysis should be made for everything single title in the balance sheet ranging from cash accounts to common equity.

- ❖ Limit or avoid the use of macros and iterations to resolve circular references as circular references are not present in the real world and fixing circularity makes many risk analysis programming techniques more difficult.

- Use the balance sheet and other items as auditing tools and include a separate “integrity” page of the model to present verification checks. The verification should point to the location of the model errors so you do not have to look around the model to find problems. Include a “dashboard” at the top of each page of the model to monitor the integrity and key outputs of the model.

- Assure that no formulas in the output module of a model affect anything in any other section of the model. This means that you should be able to delete the output section without causing any reference errors in the mechanical calculation parts of the model.

- Test various balances such as the debt balance, the net asset balance, the reserve balance and other items relative to the opening balance using the MIN function instead of IF statements. The MIN function together with the opening balance puts a cap on things that can lead to negative balances. For example, the scheduled debt repayment can be capped at the opening balance – you do not want to pay more than the existing balance back to the bank.

- Use the positive number convention which means that individual items are shown in the model as positive numbers and subtotals are explicitly shown as additions or subtractions. For example, capital expenditures are listed as positive in the cash flow statement with the caption “less: capital expenditures” and cash flow after capital expenditures subtracts the capital expenditures.

The above principals seem obvious when written down in a book. However, in the midst of creating a model to meet a deadline, it is very easy to ignore these principals as they seem to slow you down when working under a tight deadline. Examples of bad practices include entering input data in the fifth sheet of a model; including complicated revenue and expense calculations with long if statements directly in the income statement; forcing the balance sheet to balance using some king of a cash balancing item; computing interest expense without separately listing debt issues and being consistent with time periods.

The single worst practice that is often made by otherwise very good modellers is to make formulas that are too long. An example of a formula (for projected prices) that is not transparent and almost impossible to verify is shown below:

```
=IF(AB5<14,IF(AB2=6,AA39*(1+inflation),AA39),IF(AB5=14,'OperatingInputs'!$E$103/'OperatingInputs'!$
E$104,IF(LEN(AB5)=2,AA39,AA39*(1+inflation))))
```

This formula, taken from an actual model, contains a number of bad practices. One problem is that fixed numbers are included in the formula (i.e. the number 14 and the number 6.) The larger problem is that the formula is far to complex to easily verify and audit. This formula could be vastly improved if one would split it up into a number of separate rows where one would show the inflation rate in a separate row, the tests in separate rows and the alternative results of different conditions in various rows. If you would be asked to review somebody else’s model, it is a good idea to split up formulas like this one. This formula took about fifteen rows and once the more transparent separate rows were presented, several obvious errors were apparent.

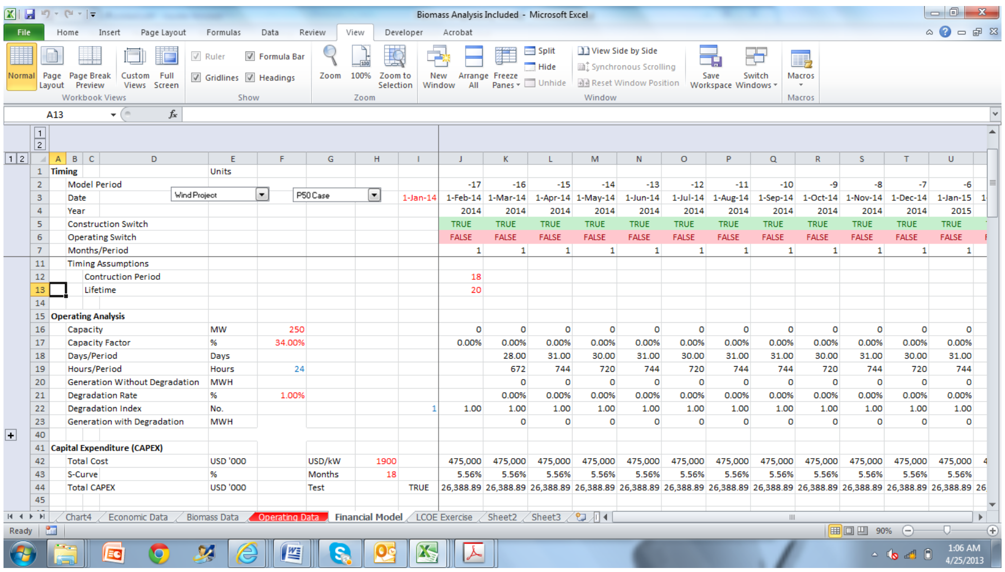
How to Make Financial Modelling More Efficient and Accurate

The paragraphs below highlight a few programming techniques that implement some of the concepts listed above so that your model does not become a complete mess. If you are more interested in general modelling concepts rather than the implementation details or you want to be able to read models but not to program them, you should skip the detailed discussion of practical programming and begin reading the next section on time periods and valuation.

Creating Short-cut keys and Setting-up the Model Area so you can build your Model Really Fast

This seems like a trivial little detail, but in structuring a model you can make it much easier to read – the transparency objective – by doing a few things before you start typing a single number in the sheet.

Models generally are presented in a similar manner to financial statements from annual reports where time (years, quarters or months) is shown across columns and items such as revenues listed on different rows. In setting up the columns, it is nice to include some thin columns at the beginning of the sheet so that you can press the CNTL, UP and the CNTL, DOWN keys and move from section to section. The time line section will often be the first section followed by the assumptions section, the operations section and the depreciation section. By putting headings in the first column (e.g. the word timeline, assumptions, operations etc.), you can move from section to section. In most type of models it is also good to leave a few blank columns after you type in titles and to the left of the model equations. In these columns after the account names you can list the inputs, transfer inputs that drive the equations and you can incorporate checks of various items. This is part of the process of being transparent where a reader can hopefully visualise how the equations are working as shown in the example below.



Using short-cuts rather than using the mouse will enable you to work faster you more easily develop and modify the model. (In some financial modelling courses imposed on young bankers, the mouse is removed from computers so students learn how to navigate around spreadsheets much more quickly, lest they waste a minute in creating collateralized debt securities out of sub-prime loans.) Use of short-cut keys may seem a bit odd when you first use them instead of the mouse, but if you practice, they really can make your work on the model easier. One of the most helpful shortcuts is the combination of the following two keystrokes that allows you to very quickly copy and paste rows in a financial model:

1. Press the SHIFT,CNTL, → (right arrow) at the same time to mark a row, and
2. Press CNTL,R to copy the formula or data to the right.

The problem with this short cut is that it copies the contents of the first cell to each column of the sheet, all the way to the right end of the sheet. To limit the copying of columns to the maximum rows of your sheet – the maximum number of periods that you may forecast, you can hide the columns for which you do not want the item to be copied. To hide columns to the right of the model periods, you can group all of the columns to the right of the last column in your program. To use this method, use the SHIFT,ALT,→ combination to group columns and press the number one on the top left corner of the spreadsheet as summarized below:

1. Shade the entire column of the first column to be hidden (you can used the CNTL, Spacebar combination)
2. Press the SHIFT, CNTL, → to shade the remaining columns in the sheet
3. Use the SHIFT, ALT, → combination to group the remaining the selected columns.

4. Press the Number 1 in the square box at the top left of the sheet.

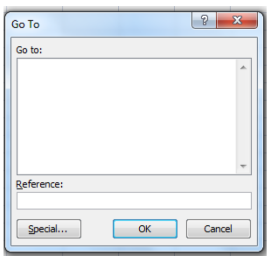
If you need the columns to the right, you can press the number two button instead of the number one key. Results of the grouping approach are shown on the diagram in the next section where the right part of the sheet after the columns have been grouped is grey.

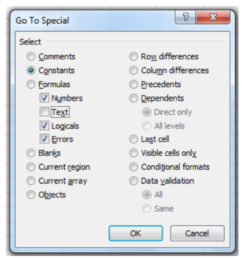
Short-cuts are pretty cool, but it is even more impressive to build your own. Use capital letters.

```
'
' Keyboard Shortcut: Ctrl+Shift+P
'
  ActiveCell.FormulaR1C1 = ActiveCell.Value * 100
  Selection.NumberFormat = "#,##0.00"
```

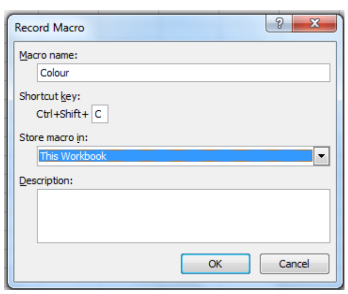
Colour Conventions and Creating the SHIFT, CNTL C Macro to Colour Inputs

In a well structured financial model, colours should be used as a guide to what is happening in various cells of the model. This means the colours should not be used to make the model into an attractive piece of art, but it is better that they provide readers of the model with a quick understanding of where the numbers in a cell come from. One principle is that input cells should be collared differently from other cells, generally through using the fill colour and the background colour. There are few methods to colour inputs. A simple method is to use the F5 key and then the press the special key. Then select the Constants option and find all of the inputs. After finding the inputs, simply select the selected foreground colour.





When using the F5 and the paste special, you can create the process in a macro and redo the process every time that you make a change. When creating the macro you can assign the macro to a CNTL key and use then have your own short-cut key such as SHIFT, CNTL, C to re-do the colours at any time. You can create similar short-cut keys to format your spreadsheet. For example, if you want to format a percentage you can press CNTL,% (SHIFT, CNTL, 5), However this short-cut key does not present decimals. If you want to show decimals, go to a cell that you want to format (this is important) and then start recording a macro. When creating the macro, press the SHIFT B or some other letter and change the number of decimals. Then simply stop recording the macro. The picture below shows how to begin recording the macro.



A second principle is that a different font colour should be used for cells in which data comes from another sheet. For example, if price data is transferred from the input sheet to the workings sheet, that cell should have a colour to notify users in what sheet they can quickly find the source of the data. A macro that sets the font colour of a cell from the tab colour of the sheet included with the materials. Other colours can be used for cells that have been computed from the goal seek or the solver and for cells that are computed through the operation of a macro. Finally, cells in which calculations are made from information in the same sheet should not have a font or a fill colour.

The example below illustrates a few of the set-up ideas discussed above. The sheet (from an integrated consolidation model) is set-up using the SHIFT, ALT, → method to limit the size of the sheet with the grouping method (when you press 1 at the top left, the columns are hidden, while when the number 2 is pressed, the columns are unhidden.) The red cells come from the target company financials which has a red tab colour while the blue cells come from the acquirer sheet that has a blue tab colour. Finally, the example illustrates that it is a good idea to make a few small columns on the left of the spreadsheet so that it is clear what rows are sub-totals and headings.

Use of TRUE and FALSE Switches and Creating a Model Integrity Page so that Excel Tells you Where your Problems are and you do not have to Continually Check Various Different Sheets in Your Model

Part of an efficient model design is creating a method where the program itself presents things that do not work – this is the accurate criteria. It is best to come up with a message somewhere at the top of each sheet that documents the location of problems with the sheet so you do not have to continually look around the spreadsheet. A useful technique is placing a "dashboard" on each page of the model that shows key outputs, inputs and sensitivity analysis switches. In addition, the dashboard on each page should show an overall check on the integrity of the model – does the balance sheet balance, is the debt balance positive, are the dividends non-negative, do the sources of cash equal the uses of cash and so forth. Sometimes it is useful to include a series of audit checks as to whether debt is in default as well as mechanical checks.

An effective way to set up the integrity check of a model is to use TRUE and FALSE logical variables created in excel in various different ways. The use of TRUE and FALSE switches is helpful in many parts of the model. For example, use of TRUE/FALSE variables eliminates the need for painful nested IF statements that can be very difficult to audit and the variables can be used to test covenants and run the model in different modes of operation. A TRUE/FALSE variable can be created by simply using and equal sign (for example, =1=1 is TRUE). It is often useful to apply the AND function together with a series of logical variables to test if the overall value is TRUE (for example AND(1=1,2=2) is TRUE.) Further, when IF statements are used, they can be used with the TRUE/FALSE in the logical section of the statement. The following step by step process illustrates how to create a verification page:

Step 1: After computing the balance sheet, subtract the assets from liabilities on a separate line. Create similar calculations for the debt balance, the sources and uses of funds and other items. Creating a good test can be a creative process.

Step 2: In a separate row, use a TRUE/FALSE logical variable (created by setting one cell equal to another) to test whether the difference, after rounding, is equal to zero. (The rounding is necessary because the difference is often not precisely equal to zero if, for example, there is a division by three somewhere in the model).The formula is

=ROUND(difference,3) = 0.

Step 3: Once such the TRUE/FALSE result is established for each period, the AND function can be used to test whether the balance sheet balances in every single one of the periods. The AND function is used on a range of TRUE/FALSE logical variables and placed to the left or the right of all of the year by year tests as illustrated below.

The figure below illustrates the verification of the balance sheet that feeds into an aggregate balance sheet test. The row labelled "test" uses a switch and the ROUND function to make sure the balance sheet balances in each period. If all of the tests are TRUE, then the aggregate test computed with the AND function is also TRUE.

	8-Sep-08	31-Dec-08	31-Dec-09	31-Dec-10	31-Dec-11	31-Dec-12	31-Dec-13	31-Dec-14
Balance Sheet								
Plant Assets	990.00	1,030.00	1,071.60	1,114.86	1,159.86	1,206.65	1,255.32	1,305.93
Less: Acc Depreciation	-	15.40	66.90	120.48	176.22	234.22	294.55	357.31
Net Plant	990.00	1,014.60	1,004.70	994.38	983.64	972.44	960.77	948.62
Senior Debt	306.90	222.51	140.33	41.04	-	-	-	-
Mezz Debt	336.60	369.92	406.55	446.79	348.01	165.50	-	-
Equity	346.50	422.16	457.83	506.55	635.63	806.94	960.77	948.62
Total	990.00	1,014.60	1,004.70	994.38	983.64	972.44	960.77	948.62
Difference	-	-	-	-	-	-	-	-
Test	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Aggregate	TRUE							

Step 4: Link the TRUE/FALSE result from the AND statement to a page of the model that contains other verification checks (for example, in a project finance model or an acquisition model, check whether the sources of funds equal the uses of funds.)

Step 5: Create a separate verification page that combines the balance sheet test with other tests (again using the =AND function) to develop a test for the overall integrity of the model.

Step 6: Identify the sections of the model that have problems using an if statement that uses the title of the test and the result of the test. The if statement has the form:

IF(test,"",title)

For example, when applying the balance sheet test, the test in the above formula would be the aggregate TRUE/FALSE test from the model. The title would be something like "Balance Sheet Test".

Step 7: Once the sections of the model with problems are identified, make an aggregate presentation of all of the problems in the model. This cell can then be placed in each sheet and each sensitivity analysis to allow you to find problems without looking around the model each time. The aggregate presentation has the form:

=problem1&problem2&…..&problem10

In this equation the problem1, problem2 cells come from step 6 above. The "&" function allows the text to be put together (as if you were adding things.) For better presentation, it is a good idea to put a space before each title so the problems are delineated. You can also create your own function add the text together which is illustrated below. To write your own function simply go to a macro and type the text below existing code.

```
Function sum_labels(series)
num = series.Count
For i = 1 To num
   tot = tot & " " & series(i)
Next i
sum_labels = tot
End Function
```

An example of a page that shows verification checks is illustrated in the figure below.

Check Title	Test	Problem Identification	Formula
Sources and Uses	TRUE		=IF(E3,"",D3)
Non Zero Debt Balance	TRUE		=IF(E4,"",D4)
Dividend	TRUE		=IF(E5,"",D5)
Debt Percent > 100	TRUE		=IF(E6,"",D6)
Target DSCR <> Actual DSCR	FALSE	Target DSCR <> Actual DSCR	=IF(E7,"",D7)
Leverage More than 100%	TRUE		=IF(E8,"",D8)
Negative CADS	TRUE		=IF(E9,"",D9)
Fixed Debt Service = Applied	FALSE	Fixed Debt Service = Applied	=IF(E10,"",D10)
Balance Sheet	TRUE		=IF(E11,"",D11)
Aggregate Test	FALSE	Target DSCR <> Actual DSCR Fixed Debt Service = Applied	=F3&F4&F5&F6&F7&F8&F11&F9&F10
Dasboard Presentation ---->		Target DSCR <> Actual DSCR Fixed Debt Service = Applied	=IF(F13="","Model Ok",F13)

Step 8: Place the final aggregate presentation of problems with the model in the dashboard that monitors each page of the model.

Chapter 6: Structuring Time Lines and Understanding the Importance of Different Phases in Corporate and Project Finance Models

When filling out applications, when discussing your life and when evaluating your performance in various tasks ranging from sporting competitions to employment, one of the first questions that you are generally asked is your birth date. The same general notion applies to companies or projects, where dates, ages and life stages go a long way in defining the model. The starting point for a well structured financial model should be a carefully defined time line beginning that contains the starting point and ending point of an analysis, just as the most fundamental aspect of a person's life that is reported on his or her tombstone is the date of birth and the date of death.

Efficiently structuring the time periods assures that you can you to gauge the effect of issues such as the length of the holding periods of an acquisition, delays in the construction of a large project, lengthening of the life of a concession period in project finance, or evaluating the amount of time before which a stable growth rate is achieved for a corporation. From a mechanical perspective, carefully setting-up time periods allows calculations of items such as interest during construction, terminal value, depreciation and amortization, debt service reserve repayments, gain on sale of assets and other items. Much of the flexibility in a financial model comes from carefully setting up a time line.

Timing in Corporate Finance Models – Distinguishing the Historic Period, Explicit Period and Terminal Period so your Model will be Flexible and Adaptable to Financial Updates

A corporate model should contain a historic period, an explicit forecast period, a valuation date, a terminal period and sometimes a fade period. For these models, the structure of time periods should begin with definition of the historic period that is defined from the availability of financial statements and allows you to update the model with actual financial data. In corporate valuation and modelling there is a great deal of subjectivity in estimating future growth – you know that high growth cannot last indefinitely simply because of the law of large numbers. But claiming that you know exactly when growth will slow down and how much it will slow is not only arrogant, but fraudulent. When creating a model it is therefore useful to construct the model so as to be able to evaluate different periods before which the explicit forecast period ends.

The historic switch maybe the most essential concept in the efficient design of a corporate model. The most painful part of a corporate model is generally acquiring historic data (sometimes from copying PDF

files) and finding the data for plant balances, maintenance capital expenditures, production levels and so forth. The last thing you want to do is to have to repeat this process over and over again each period new data becomes available. The time period switch can be established by using a simple logical variable just below the time period as follows:

HISTORIC SWITCH = Year <= Last Historic Year

Placing a historic switch at the top of the page just below the years of the model allows you to do the following:

- You can change the last historic year and seamlessly add another year of data without having to change any of the formulas; without having to add columns and without having to change the valuation formulas in the model. When entering a formula for things like accounts receivables to revenues, you can make a formula that uses the historic switch as follows:

  Historic A/R to Revenues = IF(HISTORIC SWITCH, A/R Level/Revenues)

  This formula produces a value of FALSE for periods after the historic period and will update the calculation when new data is entered as subsequent data becomes available. Often it is helpful to leave out the false condition in an IF statement and allow the model to present FALSE when something cannot be calculated. In this case the FALSE shows up in the projected years.

- You can model miscellaneous items such as other income as the last historic level or as a fixed level of zero by using another IF function as follows:

  Historic/Projected Other Income = IF(HISTORIC SWITCH, Historic Level, Prior Level)
  or
  Historic/Projected Other Income = IF(HISTORIC SWITCH, Historic Level, AVERAGEIF(HISTORIC SWITCH, TRUE, Historic Amount)
  or
  Historic/Projected Other Income = IF(HISTORIC SWITCH, Historic Level, Fixed Level)

  If the a fixed level is used, the fixed level should be shown in a cell at the left of the historic data after the titles.

- You can enter assumptions that have different levels for different years by using the INDEX function together with the HISTORIC SWITCH. An effective way to present assumptions is to show the historic level and then a series of different possible assumptions using a scenario code. In this case the formula is a bit long but very useful:

  Historic/Projected Price = IF(HISTORIC SWITCH, Historic, INDEX(Scenario Column, Code))

- For other assumptions where the number can be constant such as accounts receivable to revenues, depreciation rates, earnings rates on associated investments, variable general and administrative costs and so forth, it is often simpler to enter a single number rather than a time series of changing assumptions over time. In this case the historic switch is used again, except that the second part of the if statement contains a fixed value. This fixed value should be shown in a separate cell to the left of the historic data between the titles.

  Historic/Projected Rate = IF(HISTORIC SWITCH, Historic, Fixed Level)

- For some assets and liabilities that are held constant after the historic period, the HISTORIC SWITCH can be used with an IF statement to hold the values at the value of the last historic balance sheet using the following formula:

  Historic Projected Balance = IF(HISTORIC SWITCH, Historic, Prior Level)

The excerpt below illustrates the various different ways the HISTORIC SWITCH can be used in developing assumptions and presenting the forecast next to the assumptions. The simple incorporation of a time switch allows the presentation of assumptions to be more transparent and the time switch also makes the model flexible with respect to the addition of new time periods when more data becomes available. The formula in column H illustrates how the historic switch in row 2 is used to develop different types of assumptions.

Year			**2006**	**2007**	**2012**	**2013**	**2014**
Historic Switch	2012		TRUE	TRUE	TRUE	FALSE	FALSE
Steel Price							
Steel Revenues		=I6	8,014	11,908	14,208	0	0
Hisory		=IF(I2,I6/I7)	5.54	7.80	9.97	FALSE	FALSE
Base Price Case						10.00	10.00
Low Price Case						9.00	8.00
High Price Case						10.50	11.00
Price Sensitivity Case						10.00	10.00
Base Price Case	1	=IF(I2,I193,INDEX(I195:I198,F200))	5.54	7.80	9.97	10.00	10.00
Assumptions for Income Statements Not in EBITDA							
Other Income Statement Items							
Loss on Disposal/Impariment of Assets		=IF(I2,I19+I20,AVERAGEIF(2:2,TRUE,401:401))	41.00	33.00	469.00	290.29	290.29
Foreign Exchange Gains and Losses			48.00	-55.00	-41.00	1.43	1.43
Other Gains/Losses	0	=IF(I2,I28+I29+I30+I31,F403)	-49.00	-63.00	272.00	0.00	0.00
Income from Associated Investments							
Historic Income			40	88	1	0	0
Historic Balance Sheet Associated Investments			1,494	592	561	0	0
Average Balance of Associated Investments			1,494	1,043	612	281	0
Historic Return on Associated Investments		=IF(I2,I406/I408)	2.68%	8.44%	0.16%	FALSE	FALSE
Projected Return on Assoc	5%					5.00%	5.00%
Historic/Projected Return on Associated Investments		=IF(I2,I410,I411)	2.68%	8.44%	0.16%	5.00%	5.00%

The HISTORIC SWITCH is also useful in after the inputs are developed and the working section to compute EBITDA or to compute depreciation and debt issues are developed. In computing items where growth rate assumptions are made, the growth rate assumption can be entered first and then the amount can be derived with the HISTORIC SWITCH as follows:

Projected Amount = IF(HISTORIC SWITCH, Actual, Prior Year Amount x (1 + Growth Rate))

When working through assumptions it is useful to test whether all accounts have been included and whether the historic amounts computed correspond to the historic amounts reported in the financial statements. If the EBITDA is computed as revenues less operating expenses other than depreciation, the difference between the computed level and the reported level can be computed. Then, the difference can be summed over the historic period using the HISTORIC switch using the SUMIF function as follows:

Sum of Difference = SUMIF(HISTORIC SWITCH, Computed difference).

Once the sum of the difference is computed, a test can be developed by testing whether the sum is equal to zero:

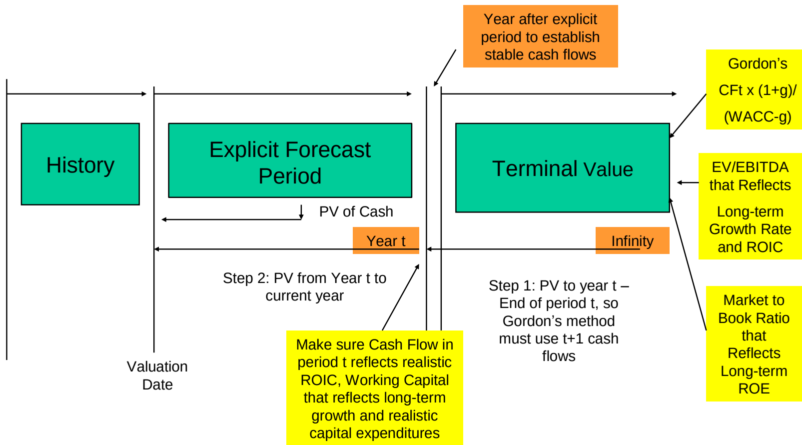
Test of History: Sum of Difference = 0

In creating various accounts in a corporate model such as the plant balance, the cash balance, the debt balance, the equity balance and others, the HISTORIC SWITCH can be used to move seamlessly from reported levels to projected levels. For historic years, the closing balance should come directly from the balance sheet while for projected years, the closing balance is the opening balance plus changes that are projected for the current period. Using the HISTORIC SWITCH in this manner is illustrated with the formula below:

Closing Balance = IF(HISTORIC SWITCH, historic amount; opening balance + change)

Corporate models can also be structured to include a fade period in which cash flow growth declines from the rate achieved in the terminal cash flow period until a stable growth rate is obtained. In the fade period the growth rate in revenues moves from the relatively high short-term growth to a sustainable growth rate over the long-term, the operating margin may move for the current returns to returns that are reasonable to expect in the long-run and capital expenditures move to levels that are consistent with growth rates and the lifetime of the assets. The diagram below illustrates different time periods in a corporate model and the importance of the assumptions developed for the final forecast period.

Terminal Value in Corporate Model



In modelling time periods for a corporate model, complications arise if the valuation date does not occur at the end of a calendar year (for example 1 March). The explicit period should be flexible so that the effects of different growth rates and returns can be evaluated. One of the tricky things in developing a corporate model is making the historic period flexible so that you can new historic periods without re-writing the model.

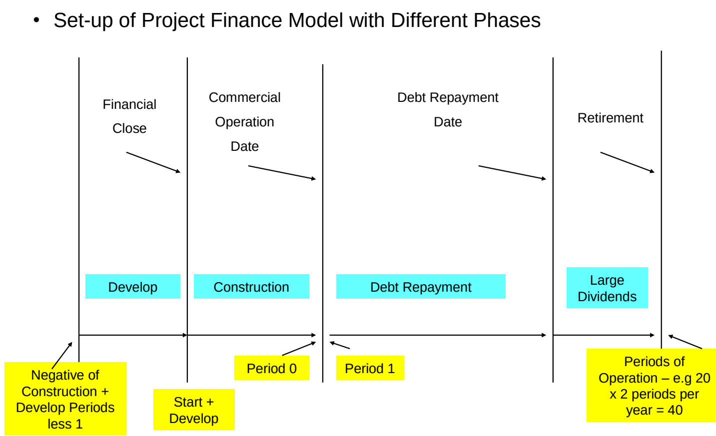
Timing in Project Finance Models - Different Phases in the Life of a Project from Development to Decommissioning

Structuring the dates is particularly important in project finance models where alternative accounting, financing and most importantly risk analysis occurs for different phases of the project. The stages that occur when making a new investment can include the time period when the project is being developed before construction – the development period; the period when construction occurs and investors are putting money into the projects; the period of operation of the project, and finally, the period in which the project terminates. Many mechanical calculations in a model are different for these different time periods. Further, the length of the periods in a model should be flexible and allow for the lengths of various phases of a project such as a delay in construction.

The number of periods can differ in project finance models depending on the phase of the project. In many project finance models, the construction period is presented on a monthly basis in order to accurately measure interest during construction since the calculation requires accumulation of debt for each month. On the other hand, when the plant begins operation, the model switches to semi-annual periods because of debt is repaid on a semi-annual basis. In order to construct time periods, one can create switches that define each phase of the project as well as the important millstone dates such as the financial close and the commercial operation date. The programming of different phases can become quite complex if the millstone dates do not start at the beginning of a month and if there are different time periods modelled in each phase of the project. The key behind making the modelling relatively simple is to make a period code which is one at the commercial operation date, negative during operation and

development and measures the age of the project. After the model is created with detailed time periods, it is convenient to show numbers for an annual year, for a semi-annual period or a quarterly period if the model is constructed with detailed monthly periods.

The figure below illustrates how various stages of a project can be modelled with a period code. The mechanics of developing the various switches is discussed in the section below. The interesting theory associated with the different stages is how the value of a project changes as the risk of the project changes at different phases of the project.

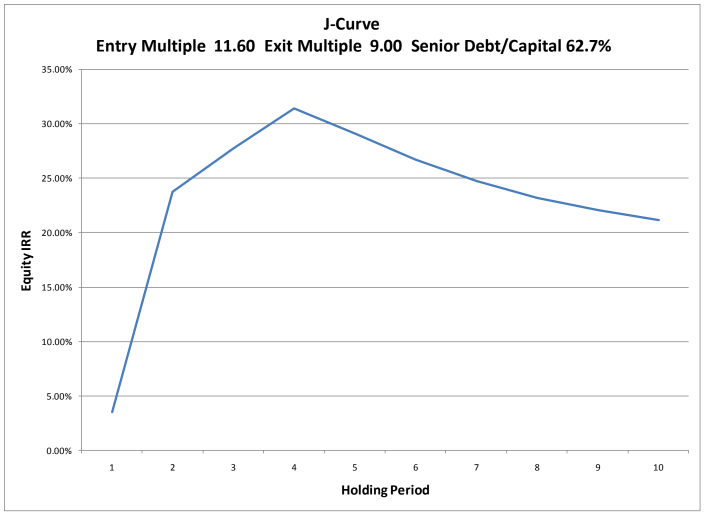


Timing in Acquisition Models – Separating the Transaction Period, the Holding Period and the Exit Period

In the case of acquisition models, setting-up time lines and time period indicators is just as important as corporate or project finance models so as to effectively measure risk and return. For acquisition models, different calculations are made for the acquisition period, the holding period and the terminal period. Through effectively setting-up time periods, a corporate model can be effectively converted into an acquisition model where dates of transactions can occur at different times, different historic periods can be added and alternative holding periods can be simulated. When initially constructing time periods in the model the following guidelines can be followed:

- The acquisition period should be a separate period in the model that only lasts one day so that the mechanics of the on-going calculations are not mixed up with the transaction assumptions.
- The period subsequent to the acquisition period can be a fraction of a year followed by annual periods until the final sale period.
- The exit period can be separate from the holding period in order to isolate on assumptions with respect to the sale of the company.

Developing periods in this manner allows the model to handle movements in the transaction date as well as alternative holding periods of the investment. As with a corporate model, one can evaluate what happens to the rate of return earned on a transaction when the holding period of the transaction changes. With the flexible time periods defined, a J-curve illustrating how the rate of return is affected by the length of time between the purchase and sale can be established as illustrated in the graph below.



General Ways to Structure a Time Line that Measures History, Explicit Periods and Terminal Periods in Corporate Models and Measures the Phases of the Life of a Project in a Project Finance Model

The remaining part of this section addresses mechanical issues with defining time lines, indicators and methods to facilitate different modelling and risk analysis techniques. A few issues that make the time line process more manageable for all project types include:

- Reserve a separate place in the model for the time line, whether on a separate page or a separate place above the beginning of the operating analysis.
- Begin the process by defining some kind of age variable (in your personal life, your age tells a lot about you; before you are born you are assumed to have a negative age).
- Explicitly show the start date and the end date of the model beginning with the first date of history, the date of the financial close or the date of the transaction depending on the model type.
- Explicitly define the periodicity of the model in terms of the number of months per period, the number of periods per year and the number of days per period (using either a 360 day basis with the DAYS360 function or a 365 day basis by subtracting the end date from the beginning date).
- Add switch variables for items such as the construction period in a project finance model and the historic period in a corporate model.

A financial model can be established on different periodic bases – annual, monthly, quarterly or semi-annually. It may seem a bit ridiculous to create a model with monthly information for ten years into the future when it is very difficult to predict what will happen one year from now. However, creating periods that are more finely defined than twelve month increments can be important in avoiding circularity and in reflecting the structure of alternative debt instruments. While it may seem a lot more complex to make a periodic model, with a bit of investment in creating switches and dates, the periodic modelling does not have to be painful.

Using Date Functions to Compute Start and End Dates for Each Period in Financial Models

To set-up a model that includes different project phases as in a typical project finance model, it is useful to begin with a period counter that measures how old the project is in each period (this is not necessary if the timing of the model does not change in different time period). Once the time period is defined, the dates of the model can be presented. These dates can be used to establish the phase of the project. To do this, you can use the following step by step process:

- First, the length of the pre-operation period should be defined in periods (e.g. months if the model is monthly during the construction period). If the beginning of construction and the beginning of operation is input as a date, then the construction period can be defined using a 360 day year where each month has 30 days as shown below. To compute the construction periods, use the DAYS360 function and enter the start date of construction and the commercial operation date (DAYS360(start date, completion date), then divide this number by the days per period (30 for a monthly model).

Start date of construction:	1-March-2010
End date of construction:	1-December-2015
Total Days of Construction DAYS360 (begin, end):	270
Construction Periods (Divide by 30):	69

- Second, once the period code is defined with a negative number for periods before you are born (i.e. before the operation period), create a TRUE/FALSE switch that delineates the pre-operation period from the operation period. This code that defines the time period before which the project is running (or is born) is created simply by the following statement:

  Period Code > 1

- Third, use the time period code is to define the number of months per period. For example, the months per period may be one during the construction period and six afterwards. You can then use the period switch defined above to determine whether months per period in the model. (The one and the six in the equation below should be defined in the inputs).

  Months per Period = IF(Construction Period, 1, 6)

- Fourth, enter the start date and the end date using the EDATE function as described in the paragraph below. The first beginning date is the established date and the ending date is the EDATE function with using the months per period. Start with the ending period (the first period is the start date of the model) and increment the date using the EDATE function and the months per period.

  Ending Period Date = EDATE(Beginning Period, Months per Period) - 1

  Beginning Period Date = Ending Period Date + 1

  In general, it is not useful to work with days when incrementing dates. When increasing a date by one month, the new date cannot be incremented by simply adding days to the prior date (you cannot add 30.5 to the date for the previous month.) Instead of working with days, it is helpful to use the EDATE function or the DATE function. When using the EDATE function, the number of months is used to increment a date: EDATE (prior period, periods per year). If the DATE function is used, the YEAR, MONTH and DAY arguments of the function should refer to the previous date and the period per year should be added to the MONTH argument. Given the definition of periods for year from the switches above, the DATE function would be DATE(YEAR(prior date), MONTH(prior date) + periods per year, DAY(prior date)).

Including TRUE and FALSE Switches like Light Switches to Turn things on and off in Modelling Time Periods

Creation of switch variables to define phases of the models is an essential part of the process in making models flexible and transparent. When creating a switch variable that has a value of TRUE or FALSE think of a light switch that is on or off. In a project finance model, the construction phase, operating phase, debt repayment phase, and specific dates can be defined using switch variables that are on or off depending on dates defined in the model. In a corporate model switch variables should be developed for the historic period, the explicit forecast period and the terminal value period. Use of the logical variables that have a value of TRUE or FALSE already introduced above can be very helpful in the date section of a model because TRUE is equal to one and FALSE is equal to zero and because these switches eliminate the need for long IF statements. A switch can be created by simply using and equal sign (for example, = period or period <= 0). It can also be created using and AND, OR, or NOT function (for example, AND (period > 0, period <= retirement date) defines a switch for when the plant is operating. Establishing the TRUE and FALSE statements is also effective together with IF statements. One can simply use the TRUE or FALSE in IF statements and make the statements much easier to read.

Mechanically, the definition of various phases in a model can be developed by inputting various dates and then programming variables that contain switches. These switch variables which have a value of TRUE or FALSE can be used to set-up dates and program many variables that differ as a function of the phase of the investment. For example, various items may have different equations for the terminal period in a corporate model. To make programming less laborious you can make a variable that has a value of FALSE for each period except for the terminal period, which has a value of TRUE. An illustration of setting-up time period codes is shown below (note that this example and very many others are available on the associated web site). In this example, each formula is very short and simple demonstrating the transparency objective of a model that should be easy to follow.

Timing		From Input Page															
Period code			-31	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2
Pre COD		Months	Months	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE
Months per period		1.00	6.00	1	1	1	1	1	1	1	1	1	1	1	1	6	6
Period of the yr				0	0	0	0	0	0	0	0	0	0	0	0	1	2
Operating yr				0	0	0	0	0	0	0	0	0	0	0	0	1	1
Start date				1-Jul-14	1-Aug-14	1-Sep-14	1-Oct-14	1-Nov-14	1-Dec-14	1-Jan-15	1-Feb-15	1-Mar-15	1-Apr-15	1-May-15	1-Jun-15	1-Jul-15	1-Aug-15
End Date		30-Nov-12	30-Nov-12	31-Jul-14	31-Aug-14	30-Sep-14	31-Oct-14	30-Nov-14	31-Dec-14	31-Jan-15	28-Feb-15	31-Mar-15	30-Apr-15	#########	30-Jun-15	31-Jul-15	31-Aug-15
Days in period				30	30	30	30	30	30	30	30	30	30	30	30	30	30
Fraction of the yr				0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Year				2014	2014	2014	2014	2014	2014	2015	2015	2015	2015	2015	2015	2015	2015
	Begin	End	Total Periods														
Development period switch	1-Dec-12	1-Aug-14	20	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
FC date	1-Aug-14	1-Aug-14	1	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
Construction period	1-Aug-14	1-Jul-15	11	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE
COD	1-Jul-15	1-Jul-15	1	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE
COD -1	1-Jun-15	1-Jun-15	1	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE
Debt repayment	1-Jul-15	1-Jul-30	180	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE
Operation period	1-Jul-15	1-Jul-40	186	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE
Final Debt Repayment	1-Jan-30	1-Jan-30	1	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE

Examples of use of the switch variables later on in the model (which are either zero or one) include:

Construction Expenditures = Total Cost/Construction Period x Construction Period Switch
Debt Balance = IF(historic period, actual amount, opening balance – repayments)
Terminal Proceeds = Terminal EV/EBTIDA Ratio x EBITDA x Terminal Switch
Interest during Construction = Interest Accrued x Construction Switch
Stable Capital Expenditures = Capital Expenditures/Depreciation x Depreciation x Stable Switch

Once you are finished defining the detailed time periods, you can create an annual page that computes all or the variables on an annual or quarterly or semi-annual basis. This process involves using the SUMIF or the SUMIFS function along with clicking on entire rows of the spreadsheet page with detailed analysis (the page shown above). The way in which this process can be transparent and relatively simple is described in Chapter 3 under the sensitivity graph heading (as the annual numbers are often used to create graphs).

Annual Date = SUMIF(year row in periodic model, year in annual model, item in periodic model)

Computing the Age of a Project in Years in a Periodic Model that is Computed on a Monthly, Quarterly or a Semi-Annual Basis

When developing a model where time increments are not expressed on an annual basis (e.g. a monthly model or a quarterly model), it is sometimes useful to express the age of a project or an acquisition in years. Many inputs such as the credit spread, the operation and maintenance expense, production changes, the extraordinary maintenance and other variables depend on the age of a project rather than the calendar year and these variables are often expressed on an annual rather than a periodic basis. Computing the age of a project seems to be a simple issue, but it can be a little tricky. This is particularly true in cases where the number of periods is not constant over time; for example where a detailed monthly analysis is deemed necessary for the initial few years of a project life after which a quarterly model is used.

To compute the age of a project in years, you can use a simple two-step process is helpful. The first step is computing a variable that simply counts the number of periods (months, quarters, semi-annual periods) in the year. For example, in a monthly model, you would count from one to twelve and in a quarterly model you would count from one to four for each year in the model. The second step is to compute an age variable in years which increases once a new year has been reached. Increases in the age occur when the counter variable has a value of one. Difficulties in this process involve making sure that the counter begins with a value of one at the start of commercial operation and that counter variable re-starts when the periods of the model change. This step-by-step process is illustrated below:

Step 1: Compute a period counter variable. In a simple project finance model, this could be calculated using an IF statement where the counting re-starts after the maximum number of periods is reached:

IF(last period counter = maximum periods, reset to one, increment counter by one)

Step 2: Increment the age variable when the counter is equal to one. This is simply like having a birthday on one day (or month, or quarter) and increasing your age in years on your birthday.

IF(counter variable = 1, increase age, don’t increase age)

Transferring Data from a Corporate Model to an Acquisition Model Using MATCH and INDEX Functions

One of the most useful techniques in excel that can be applied in many circumstances is using the MATCH and INDEX function together. One of the applications of this technique is to create timing of an acquisition model from a completed corporate model. Say a corporate model is completed on an annual basis with annual or quarterly data. Then you would like to transfer data into a new sheet that corresponds to an assumed transaction date (that may be in the middle of the period) you can use the following approach.

- Define a valuation date and the periods per year in the valuation analysis through creating a time line corresponding to the above methods that use the approach of a starting date and an un-even date using the procedures described above.

- Assuming the corporate model is computed on an annual basis and the acquisition model will be computed on a quarterly or a monthly basis, the YEAR function can be first used to define the yearly data to be transferred.

- Once the year is established the MATCH function that finds a row or column number can be used to associate dates in the acquisition model page with the corporate model. The best way to use

the MATCH function is to not worry about shading partial columns and fixing ranges, but to use the entire row which finds the column number associated with the year from the corporate model:

Column Number = MATCH(year in acquisition model, Entire row of years in corporate model)

- Once the column number is established from the MATCH function, you can use the INDEX function that simply finds a variable given a row or column number or both. For example, assume the revenues are being transferred, then the INDEX function can be used as follows.

Revenue = INDEX(Annual Revenues, Column Number from Above)

Dates								
Start Date			1-May-11	1-Jan-12	1-Jan-13	1-Jan-14	1-Jan-15	1-Jan-16
End Date	Base Case	1-May-11	31-Dec-11	31-Dec-12	31-Dec-13	31-Dec-14	31-Dec-15	1-May-16
Year			2011	2012	2013	2014	2015	2016
Column from MATCH	Comment		16	17	18	19	20	21
Holding Period Switch			TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Terminal Period Switch			FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
Fraction of Year			67%	100%	100%	100%	100%	34%
Operating Section								
Annual								
Revenues using INDEX function			3,146.60	1,515.16	1,640.82	1,842.94	2,973.31	3,612.25
Expeses using INDEX function			3,068.40	1,520.94	1,542.01	1,701.20	2,781.63	3,273.64
Capital Expenditures			366.80	72.72	73.45	74.55	688.82	104.77
Synergies			80.00	80.00	80.00	80.00	80.00	80.00
EBITDA			158.20	74.23	178.82	221.74	271.68	418.61
Periodic								
Revenues			2,097.73	1,515.16	1,640.82	1,842.94	2,973.31	1,214.12
Expeses			2,045.60	1,520.94	1,542.01	1,701.20	2,781.63	1,100.31
Capital Expenditures			244.53	72.72	73.45	74.55	688.82	35.22
Synergies			53.33	80.00	80.00	80.00	80.00	26.89
Terminal Proceeds								
Exit EV/EBITDA			12.00	12.00	12.00	12.00	12.00	12.00
Exit Proceeds			-	-	-	-	-	5,023.33

Chapter 7: Putting the Most Important Item in a Model – the Assumptions – through Creating Flexible Inputs, Making Effective Analysis of the Top Line, EBITDA and Capital Expenditures

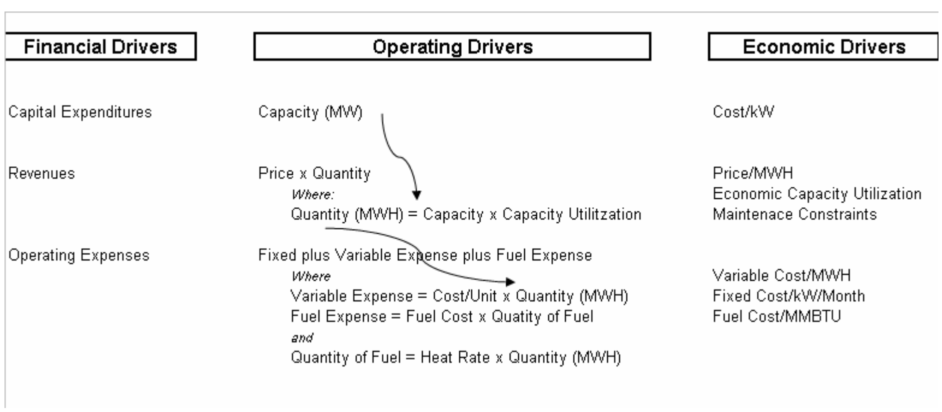
In discussing the structure of various models above (using different diagrams for the corporate model, project finance model, acquisition model and integrated model) each financial model had much in common. For example, each model began with an input section and model ended with a balance sheet. Further, each model includes a working section that computes revenues, expenses and capital expenditures; each model type has a debt schedule; each model includes a depreciation section and each model contains an income statement and a cash flow analysis. These components of models that are common to the different models are discussed in the next few chapters. This chapter begins the discussion of common model elements through describing model inputs and the initial section of the model that should compute revenues, operating expenses and capital expenditures.

Concentrating on the True Value Drivers in Financial Analysis; Demand Driven Models versus Supply Driven Models and the Danger of Overcapacity in an Industry

The most important part of the modelling process is to accurately define and analyse input items that drive the value of an investment and effectively present how the risks of the value drivers affect the ultimate value. Value drivers can be economic variables such as industry demand, behaviour of competitors, price, cost of capital expenditures per unit and the fixed and variable cost structure of investments that determine the level of three items that are the key to any model – revenues, operating cost and capital expenditures. Effective value drivers are generally not items such as revenue growth, operating margins, return on investment or the ratio of capital expenditures to sales (although for very

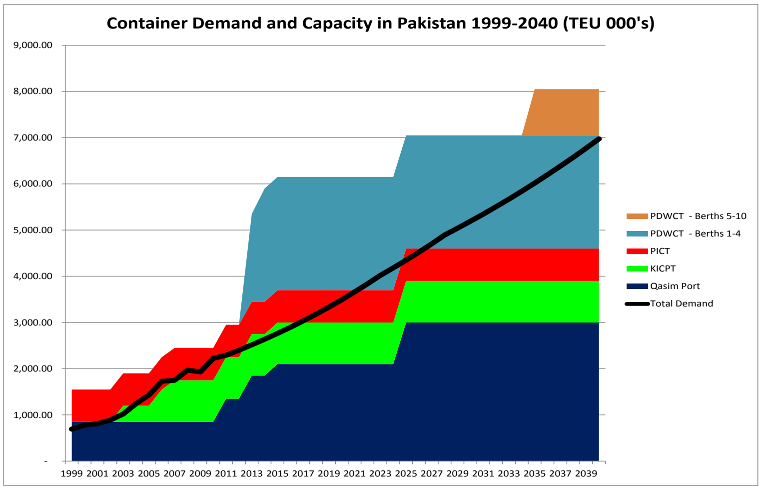
large corporations it may be necessary to use these kind of inputs.) The real art of modelling involves identifying how changes in the industry structure from capacity additions and demand changes affect these value drivers. Modelling and valuation mistakes introduced in Chapter 1 were not due to incorrectly structuring a model or having a financial model that was too simple; they were generally the result of not using valid economic and financial principles in developing industry demand, supply and price inputs to the valuation process. Subsequent parts of the book deal with how to develop inputs for prices, demand growth, cost structure, discount rates and other inputs. These inputs can be studied by reviewing historic data, performing statistical analysis, applying marginal cost concepts, and considering industry structure. In addition the value drivers should use judgment as to whether sudden non-linear changes can occur, industry expertise and perhaps mathematical simulation.

When developing a model it is helpful to think about whether profits and cash flow of a company are primarily driven by demand and market share or alternatively whether financial results are driven commodity prices and cost management. The former type of model can be referred to as a demand driven model while the latter can be called a supply driven model. The starting point for the working section of a model should generally be the capacity of the company in a supply driven model and the industry-wide demand for the product in a demand driven model. To demonstrate the difference between demand and supply driven models consider an upstream oil project. The most likely place to begin the upstream model is with the capacity of the oil fields in terms of oil and gas reserves meaning the model would be supply-driven. You would probably not begin with an analysis of the worldwide demand for oil because oil prices the company operates in a commodity business and it will most probably sell whatever it can produce. Alternatively, for a company operating in a limited market region that may have market power, the model would begin with demand for the product in the industry and market share of the company. The diagram below illustrates modelling of an electricity plant for a supply driven models. The drivers for capital expenditures, revenues and operating expenses are all determined by the capacity of the plant. Economic drivers of revenue, operating expense and capital expenditures include the cost per unit of building the plant, future trends and volatility in prices, the capacity utilization of the plant; and, the variable and fixed costs of operating the plant. The entire subject of Chapter 6 involves how to assess value drivers associated with prices and utilization rates.



The most common form of corporate and acquisition models are demand driven models where the starting point should be evaluation of industry supply, demand and prices. Case studies in Chapter 1 demonstrated that many valuation mistakes are made when over-supply occurs in an industry often because demand does not increase as expected or high returns prompt excessive new supply. When surplus capacity exists in an industry, prices can dramatically move from levels that support high returns on investment all the way down to the short-run marginal cost of production as companies fiercely fight for market share. In thinking about how surplus capacity can arise, the return on investment for firms in an industry along with barriers to entry can be evaluated. If returns are relatively high and entry of new firms is not limited, surplus capacity can come quickly. A recent example of such a phenomenon is the solar manufacturing industry where high market valuation and strong returns encouraged addition of new capacity. The new capacity led to dramatic price reductions and declines in market value.

To set-up inputs where a model that begins with industry demand and supply is illustrated on the graph below for a model of capacity and demand. Even if inputs for the industry demand and supply cannot be precisely obtained, the idea of understanding projected supply and demand conditions relative to historic levels is an essential conceptual step of the process.



Once the industry supply and demand is established, projections of market share and prices can be estimated for an individual firm. The manner in which volume demand could be established from industry demand estimates could be established from a step by step process something like the following:

Step 1: Compute the industry demand. Possible approaches to compute future demand include regression analysis, evaluation of historic volatility, extrapolation and judgment.

Step2: Compute the industry supply from exiting supply, expected new additions and expected retirements.

Step 3: Compute the industry wide margin and attribute the industry margin to the company to develop company volumes assuming that market share is driven by the capacity of a company relative to total industry capacity as illustrated using the equation below.

Reserve Capacity Percent = Industry Capacity/Industry Demand

Company Demand = Company Capacity/Reserve Capacity Percent

Step 4: Evaluate the price of the product as a function of the reserve capacity percent and the surplus capacity. In creating price assumptions an assumption can be made as to the price level relative to the amount of the surplus capacity. When the surplus capacity is high, the price can fall to marginal cost as discussed in Part 4. To implement changes in prices that result from the relationship between supply and demand, a LOOKUP function can be used. The LOOKUP function is more flexible and stable than either the VLOOKUP or the HLOOKUP functions. The LOOKUP function is illustrated below:

Price = LOOKUP(Reserve Capacity, Reserve Capacity Range, Price Range)

Creating a Flexible Structure of Inputs that Allows Changing Dates, Multiple Scenarios, Variables that Change over Time and Portfolios of Assets

Mechanically, inputs should be on the same spreadsheet page (or set of pages) and the relevant input categories should be grouped together. Generally, the inputs should begin with timing parameters

discussed in the last chapter followed by operating inputs, financing inputs and valuation parameters. Inputs can be structured on a period by period basis across a spreadsheet page or they can be entered in alternative time increments where users can insert added time periods with alternative values as illustrated below. In a corporate model, the inputs are often entered next to historic values and it may be convenient to use conditional formatting to illustrate the history in a different colour next to the forecast. Even if models are computed on a monthly or quarterly basis it is often useful to enter inputs in annual terms. Often, inputs should be coordinated with a master scenario page in which case many of the inputs come from a control page.

ANNUAL ASSUMPTIONS FOR OPERATING INPUTS										
Dates from Transaction and Timing Sheet										
First Historic Date	31-Dec-01									
First Historic Year	2001									
Final Historic Year	2011									
Historic/Projection Year	2001	2002	2009	2010	2011	2012	2013	2014	2015	2016
Historic Period	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE
Assumptions for Revenues										
Annual Industry Growth										
Scenario Number	1									
Base Case		4.72%	16.60%	20.30%	-7.91%	5.50%	5.50%	5.50%	5.50%	5.50%
Bear Case		4.72%	16.60%	20.30%	-7.91%	1.00%	1.00%	1.00%	2.00%	2.00%
Bull Case		4.72%	16.60%	20.30%	-7.91%	6.00%	6.00%	6.00%	5.00%	5.00%
Base Case		4.72%	16.60%	20.30%	-7.91%	5.50%	5.50%	5.50%	5.50%	5.50%
Historic Market Share	35%	31.15%	28.17%	24.53%	25.35%	0.00%	0.00%	0.00%	0.00%	0.00%
Product Price	195.00	199.07	227.77	229.97	221.79	228.44	235.30	242.35	249.63	257.11
Assumptions for Operating Costs										
Variable Cost	65.00	69.09	82.99	86.17	92.80	95.00	97.38	99.81	102.30	104.86
SG&A percent	15%	15.27%	15.70%	15.67%	15.37%	15.37%	15.37%	15.37%	15.37%	15.37%
Assumptions for Capital Expenditures										
Company Additions	600.00	0.00	0.00	0.00	0.00	200.00	0.00	100.00	130.00	100.00
Cost per Unit of New Capacity	0.00	500.00	574.34	585.83	597.55	612.48	627.80	643.49	659.58	676.07
Maintenance Capacity Percent	2.44%	2.44%	2.44%	2.44%	2.44%	2.44%	2.44%	2.44%	2.44%	2.44%

The inputs should be set-up in a way that anybody can easily find the inputs and understand exactly what each input means. For example, a model has a input labelled "development percent" may be confusing because one has no idea what is the basis for the percentage. Inputs should allow the model to be adjusted and not be restrictive. For example, when there is one inflation rate applicable to all future years, the model has limited flexibility. Third, the inputs should be arranged in a logical manner and grouped together by categories. Separate sections can be shown for inputs for the general transaction – dates, purchase prices and so forth; operating revenue and expense drivers; capital expenditures; financing parameters; and tax assumptions and other items. Finally, when using the inputs in other sections of the model, the inputs should be repeated and not used in the middle of the calculations.

Setting-up Inputs for Scenario Analysis with Forms, Code Numbers and the INDEX Function

One of the most important uses of financial models is to develop risk analysis discussed in the next chapter. To prepare the model of risk analysis, one should set-up inputs to the model in anticipation of the risk analysis through entering different possible scenarios in the data input section. For many inputs such as volume growth rates, prices, interest rates and other factors, different scenarios may have changing value over the forecast period. Mechanically, when inputs can take on different values over time and the task is to enter input data without inordinately cluttering up the model. An effective way to enter input data with changing values over time and different possible scenarios is to use of forms together with the INDEX or CHOOSE. The general process of setting-up flexible input variables that can change over time at different date increments is summarized below:

Step 1: Enter a scenario number associated with an input. This scenario number will allow you enter an entire row of column of data into the model.

Step 2: Enter data for a series of rows or columns associated with the input that can change over time. When entering there should be some time tag such as a year number or a date that can be used to associate the input with correct columns in the financial model.

Step 3: On a blank row below the list of scenarios or to the left of the scenarios, use either the CHOOSE or the INDEX functions along with scenario number from step 1 to compute the input variables that will be used in the analysis. These two functions simply find a number from a group of numbers according a given row or column number. Recall that the INDEX function works by shading an area or a group of numbers in a row or column together with a single row or column number that defines which number in the group to select. When using the INDEX function, you should shade the items for one period and then use the scenario number (and lock it with the F4 key for the row or column.)

Step 4: Once the variable is defined, use the LOOKUP function to insert the appropriate variable into the financial model. To use the LOOKUP function, use the relevant time period indicator in the financial model as the look up index. Then shade the time period in the input data and finally shade the items that will be transferred from the INDEX function.

The example below illustrates how to set-up flexible inputs. The first part arranges inputs by row where the inputs correspond to the year and the INDEX function is below the three inputs that vary year by year. The second input is arranged by column the discount rates correspond to the stage of a project and the numbers are arranged in columns. In this case the timing of the input is flexible according to the date to the left of the input that in turn corresponds to the date timeline. The final data item uses a spinner button that is discussed in Chapter 3 and the colours are made using the SHIFT,CNTL,C homemade short-cut key discussed above.

Show Comments			2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
General Inflation rate (annual)														
Inflation Rate Scenario	Code	1												
Start of Inflation Index	Date	1-Dec-12												
Base case	%		1.78%	1.70%	1.41%	1.53%	1.56%	1.52%	1.61%	1.58%	1.66%	1.73%	1.82%	1.81%
Zero Inflation Case	%		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
.5/1%/2% Inflation	%		0.50%	0.50%	0.50%	0.50%	1.00%	1.00%	1.00%	1.00%	2.00%	2.00%	2.00%	2.00%
Base case			1.78%	1.70%	1.41%	1.53%	1.56%	1.52%	1.61%	1.58%	1.66%	1.73%	1.82%	1.81%
Discount Rate for Future Cash Flows														
Discount Rate Scenario		1												
Discount Rate for Equity Cash Flows	Date	Base		Base	Low	High								
	1-Dec-12	20.00%		20%	15%	22%								
	1-Mar-14	18.00%		18%	14%	19%								
	1-Mar-17	14.00%		14%	12%	15%								
	1-Feb-15	11.00%		11%	10%	12%								
	1-Feb-40	7.00%		7%	7%	9%								
General Cost of Capital for LCOE Calculation	%	6.50%		65										

Projecting Inflation, Revenues, Expenses and Capital Expenditures in Working Analysis

In constructing the working section of a model that projects essential free cash flow items – revenues, operating expenditures and capital expenditures, making clear presentations using short formulas that are easy to follow should guide the modelling process. Many of the items are modelled using the time period switches discussed above. For example, in a project finance model the capacity of a project begins during the operating period which is defined with a switch. In a corporate model, the gross margin is computed using actual data with the historic switch and then switches to the assumptions when the historic period is FALSE. When computing formulas for inflation projections associated with these items, various problems can arise when time period lengths change and when intervals are used for inputting the inflation rate and when the starting point for inflation indices are not clearly laid out in the input section. In general inflation should be included in the analysis as it is more difficult to convert depreciation and taxes into real terms than add inflation and use the nominal cost of capital.

Interest rates and inflation rates are generally input into a model as annual rates. But when modelling inflation rates using non-annual periods, it is not accurate to simply compute the fraction of the year and multiply this by the annual percentage in a periodic model. This can result in overstatement of interest or inflation because amounts will be compounded in a model. For example, assume the annual inflation rate

is very high, say 120%. If the real expenditure for the year before the year's inflation is 100, then it would be 220 including the inflation. If 10% is assumed per month, then by the end of a year with, the inflation index compounds to 3.38 rather than 2.20. To resolve this problem of over-compounding, a periodic rate can be derived using the following process.

End of period expenditure = Beginning of period x (1+periodic rate) ^ periods

and,

End of period expenditure = Beginning of Period x (1 + annual rate)

or,

(1+periodic rate) ^ periods = (1+annual rate)

(1+periodic rate) = (1+annual rate) ^ (1/periods)

periodic rate = (1+annual rate)^(1/periods) - 1

To practically apply the above formula, you can use the fraction of a full year that the model period represents as illustrated in the formula below:

Periodic Rate = (1+annual rate)^(months per period/12) - 1

Finally, when establishing the inflation rate one should be careful about the start date. When inflation assumptions are made, the fundamental data for prices, operating expenses and capital expenditures per unit are is input in real terms at some given date. To start the inflation index at the appropriate date, you can create a switch and only turn on the inflation rate after the inflation start (this will keep the inflation index at one until the beginning of the inflation period.) The diagram below illustrates components of a working analysis with varying inflation.

Project size	*MW*	10		-	-	-	-	-	-	-	-	-
Days per period	#			30	30	27	30	29	30	29	30	30
Hours per period	*h*			720	720	648	720	696	720	696	720	720
Annual degradation	*% annual*	0.70%		0.70%	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%	0.70%
Periodic degradation				0.06%	0.06%	0.06%	0.06%	0.06%	0.06%	0.06%	0.06%	0.06%
Degradation index			1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Base Capacity Factor	%	15.00%		15.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%
Low CF Years in Risk Analysis	*Year*	5.00		FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
Capacity Factor in Low Years	%	12.00%		12.00%	12.00%	12.00%	12.00%	12.00%	12.00%	12.00%	12.00%	12.00%
Capacity Factor from Above				15.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%
Applied Capacity Factor	%	TRUE	16.70%	16.70%	16.70%	16.70%	16.70%	16.70%	16.70%	16.70%	16.70%	16.70%
Generation	*MWh*			-	-	-	-	-	-	-	-	-
General Inflation	*annual %*			1.78%	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%
Periodic inflation	*Periodic %*			0.15%	0.14%	0.14%	0.14%	0.14%	0.14%	0.14%	0.14%	0.14%
Inflation index			1	1.001	1.003	1.004	1.006	1.007	1.009	1.010	1.011	1.013
General Inflation				1.78%	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%
Periodic inflation				0.15%	0.14%	0.14%	0.14%	0.14%	0.14%	0.14%	0.14%	0.14%
Inflation index			1	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Total Capital Cost	EUR 000 / MW	1,200										
Weibull Function for Spreading Cost	%			FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
Normalized S-Curve with Weibull Function	%			0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
S-Curve Test	Switch	TRUE										
CAPEX spread with Inflation	*EUR 000*			-	-	-	-	-	-	-	-	-

Taking a Breather after Computing EBITDA from Revenues and Expenses and Evaluating Pre-tax Project IRR in Project Finance Models or Pre-tax ROIC in Corporate Models

Once you have computed revenues, expenses and capital expenditures you can stop and compute a few financial ratios. In a project finance model you can calculate the pre-tax project IRR from EBITDA minus

capital expenditures. In corporate models you can compute the level of EBITDA to net assets that generate EBITDA. In project finance models, if the pre-tax IRR that can be computed on a real and nominal basis is lower than the interest rate, then you do not have to go any further with all of the tax and financing aspects of the model as the project will probably not be feasible. On the other hand, if the pre-tax project IRR yields a very high number, you should step back and ask yourself what makes you so special and why this high IRR will not prompt companies from all over the world to try and copy your project which will put a whole lot of pressure on prices, margins and fixed price contracts.

In a corporate model, computing the level of EBIDA to net assets accomplishes a similar task. The net assets can be computed from the accumulated capital expenditures. Once the ratio is computed which is analogous to the pre-tax IRR, the projected levels can be compared to the historic ratio. This notion of comparing history with projection is further discussed in Part 3 and allows you to judge whether you have made reasonable assumptions. If the rate of return on assets skyrockets compared to the history you need to ask what has changed about the company that allows it to earn such high returns. What you probably need to do in this case is go back and revisit your assumptions.

Chapter 8: Moving from EBITDA and Capital Expenditures to Free Cash Flow through Creating Working Capital Analysis, Fixed Asset Schedules and Depreciation so that Project IRR and ROIC can be Calculated

Computing Free Cash Flow before Developing Financing Section of a Model

You may be repulsed by the idea of Miller and Modigliani or may be a true believer in free cash flow and the irrelevance of the financial structure in assessing value. No mater what your opinion of the theory, the general approach of separating a financial model between operations and financing improves the structure of any financial model including project finance models, corporate models and acquisition models. Through first calculating free cash flow and only then adding the debt and equity split in the model, the structure is more logical and rigorous. Once free cash flow is computed from EBTIDA less capital expenditures, working capital changes, operating taxes and changes in deferred taxes, a host of valuations and financial statistics can be computed. In a project finance model the project IRR (but not the equity IRR) can be computed and the value of the project assets at different sale dates can be evaluated. In a corporate finance model the return on invested capital (but not the return on equity) can be derived and the discounted cash flow value can be established. Given the usefulness of separating operating cash flow from equity cash flow, the next section addresses working capital, depreciation and deferred tax items that are necessary to complete the free cash flow calculation.

Working Capital Analysis

Once revenues, expenses and capital expenditures are established, the remaining items to compute free cash flow are the working capital changes and taxes. Working capital is often computed in a simple manner directly from revenues and operating expenses in a simple way through inputting the ratio of accounts revenues to revenues, inventories to cost of goods sold and so forth. For this purposes of constructing a model, working capital includes trade working capital and does not include cash, short-term securities, short-term debt or current maturities of long-term debt. For example, if the days outstanding are 30, then one month of revenues is not collected, or about 8.33% of total revenues. The working capital section must be developed after revenues and expenses have been computed. After computing the total current assets and current liabilities, working capital is computed as the difference between the two amounts. Finally, the change in working capital is the current period working capital less the prior period working capital.

One complexity in computing working capital can involve computing inventories and accounts receivable during periods of declining demand such as occurred after the financial crisis of 2008. In a detailed model, the production can be computed separately from demand. Additions to inventories can be modelled as a function of production while deductions from inventories can be modelled as a function of demand. If there is a sudden reduction in demand without a similar reduction in production, the inventory balance will increase.

Basic Asset Schedule and Introduction to Problems in Computing Depreciation Expense in Corporate Models

In corporate finance models, project finance models and acquisition models it is useful to complete the calculation of free cash flow before incorporating financing of assets. The discussion above covered the modelling of revenues, expenses, capital expenditures and working capital that are all components of the free cash flow calculation. The remaining item necessary to compute free cash flow is the level of operating tax defined as the tax rate multiplied by the EBIT. This is a hypothetical amount of tax that would be paid if the company had no interest expense, interest income or income from other activities not related to operations. In order to compute EBIT and derive operating taxes a projection of depreciation expense is necessary. Therefore, calculating the plant assets along with depreciation is the next logical part of the structure of financial models.

Accurately representing depreciation expense in a model is important because tax depreciation effects actual tax payments; because depreciation expense affects taxes used in computing free cash flow; because depreciation expense is used in terminal value calculations where the ratio of capital expenditure to depreciation expense may be used in computing stable ratios; because depreciation expense effects reported earnings; and because depreciation expense is used it deriving stable EV/EBITDA ratios.

A few difficult programming issues can arise in modelling depreciation expense in the different types of models. In corporate models the primary difficulty is evaluating the effects of asset retirements that come about because of historic capital expenditures that were made before the start of the forecast period. For a project finance model, the retirement problem does not exist because there is no history, but other programming problems arise because the depreciation expense may be a function of the calendar year rather than the annual age of the project. Depending on the tax treatment of a transaction, distinguishing tax depreciation and book depreciation can be difficult and modelling accelerated depreciation can create challenges in acquisition models. Before addressing the difficult issues, a simple depreciation calculation from gross plant balance is reviewed.

For a single asset with no terminal value, straight line depreciation is simply the gross amount spent on an asset divided by the plant life. Given this fact, one to approach to computing depreciation expense is to establish the balance of the gross plant (i.e. without deductions for accumulated depreciation) from a table beginning with existing plant and adding capital expenditures. Gross plant balance can then be multiplied by the depreciation rate to establish projected depreciation. The problem with this method is that it overstates depreciation expense and it can lead to underestimation of taxes and inflation of cash flow because gross plant never declines as assets are retired. Instead of using the gross plant balance, one could multiply the net plant (after deducting accumulated depreciation) by the depreciation rate on net plant. Over the lifetime of a single asset, the ratio of depreciation expense to net plant – the gross plant less the accumulated depreciation expense – declines as depreciation remains constant but net plant reduces. For a company or project with many assets, multiplying net plant by a constant depreciation rate can result in biased forecasts because the depreciation rate on net plant is affected by the growth rate of the company and when growth rate changes, the depreciation rate on net plant also changes.

The discussion above regarding the EV/EBITDA ratio includes an error from ignoring retirements of plant. The analysis assumes that capital expenditures are continually added to plant without ever being retired. This overstates depreciation expense (it does not overstate the net investment balance because retirements are removed from both the gross balance of investment and the accumulated depreciation.) To correct this problem one can include both retirements of existing plant and retirements of prospective

plant that is added in the future. To model existing retirements, an existing retirement rate can be entered and formulas that test the remaining balance can be made. In modelling prospective retirements, the OFFSET command can be used so that different asset lives can be tested. The existing retirements could be the gross plant or the existing plant multiplied by the retirement rate. When modelling the existing retirements, the balance of existing plant should be tabulated (the existing plant less the accumulated retirements.) The retirements related to existing plant should stop when the existing net plant is negative and the final retirement should be the opening balance of the existing gross plant. To model the constraint that the accumulated existing retirements cannot exceed the existing plant, the MIN function can be used as follows:

Exiting Retirements = MIN(Existing Plant less Accumulated Retirements, Retirement Rate x Plant)

The retirement rate should be modelled by a balance of plant that increases or should be modelled in some other manner. If the plant has been increasing over time, the retirements should also increase over time. (One could establish a formula where a growth rate is input along with the last date of the retirements).

Separating Depreciation on Existing Assets and Depreciation on New Assets in Corporate Models

Addressing the problem of asset retirements in corporate models is difficult because information on the future plant retirements is difficult to obtain. To approximate retirements, some modellers project depreciation on existing assets using the net plant balance multiplied by the net plant depreciation rate. Depreciation on new assets is separately projected using gross plant because there are little or no retirements from new capital expenditures. As the balance of net plant declines each period, the depreciation expense also declines implying that retirement of assets is implicitly reflected in the forecast. If this net plant method is adopted, one must make sure that the net plant balance does not become negative. This can be programmed using the MIN function on the depreciation expense, where the depreciation can never be more than the opening balance of the net plant. Although this approach of splitting-up depreciation does indirectly account for retirements, it is not an accurate reflection of retirements unless the rate of retirement for existing assets (relative to net plant) is the same as the net plant depreciation rate. For example if the net plant depreciation rate is 15%, then the implicit retirement rate is also assumed to be 15%. If the retirements are less than depreciation, then the depreciation rate on net plant should increase as the net plant balance declines. There is no reason to assume that the net plant depreciation rate will remain constant.

An alternative method for modelling depreciation in a corporate model is to make an assumption with respect to the retirements as a percent of gross plant. The plant balance layout can then include both retirements and capital expenditures after the opening balance is computed from the prior period closing balance. This method also can be problematic because changes in nominal growth and the lifetime of assets affect the future retirement rate. In sum, there is no simple solution to reflecting retirements in the depreciation component of a corporate model. The issue of depreciation will be revisited in Chapter 4 where analysis of stable retirement rates, depreciation rates on net plant and other related issues is discussed in detail. These issues concerning stable depreciation, capital expenditures and retirements have large effects on the terminal value calculations and derivation of implied EV/EBITDA ratios.

Portfolios of Assets with a Vintage Process

Corporate models should include tax depreciation as well as book depreciation as tax depreciation rather than book depreciation affects cash flow. If EBIT is computed using book depreciation in the free calculation, then there should be a separate adjustment for changes in deferred taxes derived from calculation of tax depreciation. Computation of tax depreciation can be complex when the depreciation rate is not constant for each year if accelerated depreciation rates are part of the tax code. To model tax depreciation with accelerated rates and continuing capital expenditures, a matrix with a diagonal pattern is often shown in models as the depreciation expense for an asset depends on its age and information on both the age and the capital expenditure must be retained for the calculation. These matrices are

sometimes shown for straight line depreciation which is not necessary as the depreciation rate does not depend on the age of the asset (perhaps modellers want to show how sophisticated they can be). The table below illustrates calculation of accelerated depreciation for assets with an assumed four year life.

Model Year		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Capital Expenditure		100.00	109.00	118.81	129.50	141.16	153.86	167.71	182.80	199.26	217.19	236.74
		1	2	3	4	5						
	Dep Rate	0.4	0.3	0.2	0.1	0						
Born Yr	Cap Exp	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
2014	100.00	40.00	30.00	20.00	10.00	-	-	-	-	-	-	-
2015	109.00	-	43.60	32.70	21.80	10.90	-	-	-	-	-	-
2016	118.81	-	-	47.52	35.64	23.76	11.88	-	-	-	-	-
2017	129.50	-	-	-	51.80	38.85	25.90	12.95	-	-	-	-
2018	141.16	-	-	-	-	56.46	42.35	28.23	14.12	-	-	-
2019	153.86	-	-	-	-	-	61.54	46.16	30.77	15.39	-	-
2020	167.71	-	-	-	-	-	-	67.08	50.31	33.54	16.77	-
2021	182.80	-	-	-	-	-	-	-	73.12	54.84	36.56	18.28
2022	199.26	-	-	-	-	-	-	-	-	79.70	59.78	39.85
2023	217.19	-	-	-	-	-	-	-	-	-	86.88	65.16
2024	236.74	-	-	-	-	-	-	-	-	-	-	94.69
Total		40.00	73.60	100.22	119.24	129.98	141.67	154.42	168.32	183.47	199.98	217.98

To model one of these matrices, the trick is to compute the age of separate assets that are projected to be completed at different times. In the above example, the age of the asset class that goes into service in 2015 is one year old in 2015, while the age of the asset class that went into service in 2014 is two. A square can be created that shows the date the asset is born and the date of the model that allows the age at each vintage to be computed. Once the age of each vintage of plant for each asset class is established, the lookup function can be used with the age as the index to find the appropriate depreciation rate. To make the calculations, the following steps can be used:

Step 1: Enter the depreciation rate as a function of the age of the plant.
Step 2: Use the TRANSOPSE function (not the copy and paste special) to set up a matrix that has the year the asset was created on the column and the year of the model on the row. To use the TRANSPOSE function, first shade the target area, then type the function name and finally press SHIFT, CNTL, ENTER instead of simply pressing the enter key. The result called an array variable will include brackets around the result.
Step 3: Compute the age of the plant through subtracting the model year from the year the asset was born. Allow the age to be negative in years before the asset was created (use relative references by pressing the F4 key multiple times)
Step 4: Use the LOOKUP function to relate the depreciation rate to the vintage of the plant by applying the age as the lookup index and then shading the age in the depreciation table and then shading the rate.
Step 5: Multiply the depreciation rate by the cost of the asset being depreciated from the cost of the asset that was created from the TRANSPOSE function and use the IFERROR function (in excel 2007 and later) to avoid problems created by N/A.
Step 6: Repeat the process for assets with different vintages and with book and tax depreciation.

Instead of this rather long process, you can create your own function in excel that accepts capital expenditures and depreciation rates and gives the depreciation expense. The function is like the TRANSPOSE function in that the output – period by period depreciation expense -- does not go into one cell, but rather into an array of cells. To create a function that produces a row or column of depreciation expense from an array of capital expenditures and an array of deprecation rates, you need to know a couple of tricks in computing an array function. Three elements in generating an array function include:

1. Define the function as a VARIANT
2. Compute the length of the array by using the .COUNT extension

3. Create an array variable for depreciation expense using the REDIM statement to define the size of the depreciation array
4. Assign an array variable to the name of the function (rather than a single value)

The code that produces total depreciation from computing vintages is shown below. After you create it one time you will not have to program the matrix again. Hopefully, this example illustrates the benefits of using functions in excel.

```
Function depreciation(capexp, dep_rate) As Variant

num = capexp.Count
ReDim dep_flex1(num) As Variant
life = dep_rate.Count

For model_year = 1 To num
        For vintage = 1 To num
                age = model_year - vintage + 1
                If (age > 0 And age <= life) Then
                    dep_flex1(model_year) =
                            capexp(vintage) * dep_rate(age) + dep_flex1(model_year)
                End If
        Next vintage
Next model_year
depreciation = dep_flex1
End Function
```

The function that produces an array in the above case only allows you to create the function in a single row. If you would like to output a row as well as a column, the output variable can be defined as a two dimensioned array. An additional loop could then be created that defines the second part of the array as using the same value as the first as illustrated below:

```
ReDim dep_flex1(num,num) As Variant

For i = 1 To num
        For j = 1 To num
            dep_flex1(i,j) = dep(i)
        Next j
Next i

depreciation = dep_flex1
```

Depreciation Issues in Project Finance Models

In a project finance model, depreciation should be computed through establishing a gross plant balance account which increases with the construction costs over the construction period. To begin the depreciation at commencement of operation, the tax depreciation rate (which may vary with the age of the project) is multiplied by the balance of the plant as well as operating switch. As with the non-project finance models, the accumulated depreciation should be computed after the depreciation expense row. Computing depreciation can be complicated in a project finance model because of the manner in which tax depreciation is driven by the calendar year rather than the date the project begins operation. If the operation date is 27 December, the depreciation is the same as if the operation date is 5 January meaning it is much better to put the plant in service at the end of the calendar year. To resolve this problem, the number of calendar months in the year should be computed and the calendar year must be computed. Some techniques to accomplish this include:

1. Compute a switch for a new calendar year by making a test when the month of the start date is greater than the month of the end date using the MONTH function.
2. Use the switch to make a counter for the calendar year through accumulating the switch
3. Make an adjustment for the first operating year for which the counter should begin (you have to also make an adjustment so that you do not double count).

4. Use the COUNTIF function using both the range and the criteria as the annual year to find the number of periods per year.
5. The depreciation rate for the period is 1/life divided by the periods per year.

In modelling a project finance transaction, the total accumulated depreciation or amortization should not exceed the amount that has been spent. To make sure that the depreciation or amortization is limited to the net plant balance of the prior period, you can use the MIN statement. This involves first computing the accumulated depreciation or amortization and then using the MIN test with the opening balance of the net plant as illustrated below:

Amortization Expense = MIN(Balance x Rate, Opening Balance of Net Plant)

Adjusting the Tax Basis in an Acquisition

For tax purposes, an acquisition can be treated as a purchase of assets or a purchase of stock. This tax treatment must be distinguished from the book accounting for an acquisition which results in re-valuation of assets and re-establishing the equity. If the acquisition involves a purchase of assets of assets rather than the purchase of stock, the acquisition price should be have a higher value as the asset base will be higher and the value of depreciation deductions increase. In evaluating an acquisition, comparative multiples should account for the difference in value from purchase of stock versus purchase of assets as the multiples should account for the difference in tax rates for different countries. If the acquisition is a stock transaction, no write-up for tax purposes occurs, the seller does not pay tax on gain realized from selling asset and the buyer can use the existing net operating loss. Since the tax depreciation deductions take place over an extended period while the taxable gain must be paid immediately, from the perspective of both the acquiring company and the target company on a combined basis, a stock transaction generally has a positive outcome because the gain on the sale is taxable as current income while the write-up is deducted on a periodic basis. Therefore, on a present value basis, the government treasury wins and the combined shareholders of the two companies lose. In situations with net operating loss, the situation is even worse as the value of the net operating loss carry-forward is lost.

To establish the tax and book depreciation expense in alternative transaction structures, the following steps can facilitate the development of a model:

1. The existing deferred taxes can be used to derive the existing difference between the tax and book base through dividing the accumulated deferred tax related to depreciation by the income tax rate.

   Existing Basis Difference = Accumulated Deferred Tax/Income Tax Rate

2. In a stock transaction, the valuation of the assets increases for books, but the tax basis does not change. The difference in the basis increases the balance of accumulated deferred tax as demonstrated in the formula below.

   Accumulated Deferred Tax after Transaction =
   (New Book Basis – Existing Basis) x Income Tax Rate

3. When computing the goodwill for developing the pro-forma balance sheet, the increase in assets as well as the increase of accumulated deferred tax must be accounted for. In addition to other goodwill adjustments, the goodwill formula should include:

   Goodwill = Goodwill – Increase in Asset Valuation – Increase in Accumulated Deferred Tax

Chapter 9: Adding Debt to a Corporate or Project Finance Model and How to Program Cash Flow Waterfalls that Define Who Receives Cash First and Where the Cash Flow Ultimately Goes

While much of the time spent in financial modelling should be studying and analysing value drivers, it is also important to accurately reflect the financial structure so the value drivers can be translated into cash flow projections that measures risk to alternative capital providers and the structuring of a transaction. Mechanical issues that translate free cash flow into effective analysis of the risk and value of debt and equity value discussed in much of the remainder of this chapter. This section describes various modelling issues that arise when incorporating debt into a corporate, project finance, acquisition or merger model. The amount of debt that can be issued and maintained on the balance sheet is central to the general idea of using the risk analysis process of lenders to derive value of an investment which is central to many of the ideas presented in this text. Furthermore, the risk to lenders relative to the earned credit spread is also a critical subject in finance.

Given the importance of evaluating risks faced by lenders, reflecting the specific features of debt is an essential part of the modelling process. These features include the amount of debt; the repayment structure of the debt; fees paid and spreads on the debt; covenants and required debt service reserves. Depending on the transaction, the covenants and credit spreads may depend on financial ratios such as the debt service coverage or the ratio of debt to EBITDA. Similarly, the nature of debt issued in leveraged buyouts is a key driver of equity returns and the financial viability of the transaction. The structure of debt repayments, new debt issues and the credit spreads is also important in corporate models and merger integration models as the amount of debt issued in a merger can be an important driver of the accretion or dilution in earnings per share.

Adding a Debt Schedule to a Corporate Model or a Project Finance Model after Free Cash Flow has been Established

The fundamental part of any debt schedule is defining the balance of debt outstanding and computing the interest expense from the balance of the debt. The debt outstanding should be structured by explicitly showing the opening balance, the new debt issues, the debt repayments and the closing balance on separate rows of the model. These debt balance schedules should be listed for each existing and prospective debt facility that will be present during the forecast horizon. For corporate models, the debt schedule should include all of the debt issues that are outstanding as of the last balance sheet date plus any new issues that may occur over the forecast period. In the case of project finance models, the debt issues include all of the different tranches of debt that are issued to finance construction as well as debt issues for letters of credit, defaults, and debt service reserves. For project finance models, debt schedules may be set up to include re-financing. Acquisition models generally include debt issues that are used in financing the acquisition as well as debt that was issued prior to the acquisition and that will be assumed by the new owners.

The starting point for the debt schedule that establishes the closing balance differs depending on the type of model. When developing corporate models, the closing balance of each debt balance is launched from the financial inputs which should list the amount outstanding in the base balance sheet year for each debt issue. The sum of these individual issues should correspond to the total amount of long-term debt on the balance sheet (including current maturities of short term debt.) If the sum of the closing balance of all of the debt issues does not equal the balance sheet amount, the prospective balance sheet will not balance and there will be an inconsistency in debt maturities and interest expense with actual financial obligations. Therefore, a verification check to assure that the total debt on the balance sheet equals the sum of the individual debt issues can be effective in verifying the model. The process of adding a debt schedule to a corporate model includes the following:

- Set-up the debt schedule with separate lines for:
    - The opening balance

  - o Additions from new issues
  - o Subtractions from debt repayments
  - o The closing balance

- The initial closing balance is derived from inputs that tie to the balance sheet

- After the initial base period which is the last historic period, the subsequent opening balance is equal to the closing balance in the prior period

Once the opening and closing balance are established, the interest cost (whether capitalized or expensed) can be computed. For models that include capitalised interest or a cash flow sweep, it is convenient and sometimes essential to assume that repayments occur at the end of the period which means the opening balance is the basis of accrued interest. If the repayment occurs at the end of the period (say the payments to construction expenditures are made at the end of the month), then there is no accrued interest on borrowings related to the expenditures. Here, where everything occurs at the end of the period, the accrued interest is computed on the debt that was outstanding before the new debt was issued or repaid in the current period, which implies that the basis of interest expense is the opening balance. Unless the opening balance is used, hopeless circularity will arise. This idea of using the opening balance is consistent with actual payments of interest and is the primary reason periodic models are used rather than annual models. If the repayment occurs at the beginning of the period, the interest expense is computed on the closing balance. If the repayment occurs somewhere between the beginning and end of the period, the interest is a weighted average of the opening and closing balance.

Modelling Scheduled Debt Repayments

For many models, computing the debt repayment is the most complex element of the modelling process. The manner of repaying debt depends on the type of debt issue and the type of the model. Given the importance and the difficulty in computing debt repayments known as sculpting debt in project finance models, a separate section addresses the issue below. In other models, the repayment calculation can be derived from the opening balance of the debt. For example, in a corporate model where debt issues may be repaid on a single date – bullet repayments – a simple test can be created from the repayment year and this is used to assure that repayment only occurs on the repayment date. Specifically the programming involves:

- Add a line for the repayment of the debt after the opening balance
- Create a formula that compares the model year with the repayment year to create a logical variable (year = repayment year)
- Multiply the (year = repayment year) by the opening balance of the debt

The manner of debt repayment in a project finance model or a leveraged finance model is often tailored to the expected cash flows generated by the investment. For example, a project finance model may have a pre-defined set of repayment percentages that vary over the lifetime of the debt. Because of the percentages are applied to the aggregate amount of debt issued rather than the closing or opening balance it is generally a good idea to show the total accumulated amount of the debt on a separate line item above the debt balance. This accumulated balance can then be multiplied by the repayment percent or a tailored repayment schedule to establish the periodic repayments. Because of early debt repayments that can occur if covenants or cash sweeps are triggered, it is important to make sure that the amounts in the repayment row do not exceed the amount of debt outstanding. To program this, the MIN function can be used to assure that the amount being repaid does not exceed the opening balance of the debt as illustrated below. For leveraged acquisition models and/or integrated merger models, a combination of the corporate finance and the project finance approaches can be applied depending on the type of debt used to finance the acquisition.

Repayment = MIN(scheduled repayment, opening balance)

Connecting Debt to Cash Flow in Corporate Model and Circularity Created by Interest Expense

In corporate models, it is useful to set up an account that sums the cash with the negative of the debt to reconcile the cash flow with the debt balance. The account is like other debt accounts except that it begins with the cash minus the short-term debt on the historic balance sheet. Unlike other accounts, the cash less debt amount is incremented with net cash flow on the balance sheet. For example, if there is a negative net balance on in the last historic year because of more short-term debt than surplus cash and the net cash flow is positive by more than this amount, then the cash is assumed to be used to pay-off the short-term debt and then build up in surplus balances. At the end of the period, if the net cash less short-term debt account is positive, surplus cash is placed on the balance sheet. If the account is negative, then the amount represents debt. To make this presentation, after the net balance has been established, the amount can be allocated to cash or short-term debt using the MAX function as illustrated below:

Surplus Cash = MAX(Cash net of debt balance, 0)

Short-term Debt Balance = MAX(-Cash net of debt balance, 0)

In many models, a problem of circularity arises because interest expense drives cash flow, but the debt balance or the interest expense is affected by cash flow itself. The most common circularity problem in corporate models comes from the assumption that cash flows and therefore interest expenses occur in the middle of the year. (If monthly or even a daily model were constructed, the circularity would not arise because interest is paid on the opening balance of the debt and cash flow does not affect the opening balance.) If the assumption of interest expense on the opening balance cannot be applied (because an annual model is constructed), then the interest expense affects cash flow, but the cash flow affects the debt balance and interest expense. As with most circular references, the problem arises because of an artifact of the financial model – in the real world bankers do not require interest expense to be paid using a circular formula where they first compute interest expense and then re-compute the interest expense because the debt is increased by interest expense. One solution to the circular reference problem is to click the iteration button in the excel options. However, the problem with this approach is that the iterative calculations can cause models to be unstable. A more elegant method is discussed in the chapter below on resolving circular references in corporate models.

A Few Effective Tricks to Model Any Cash Flow Waterfall

Any time debt is issued to finance capital expenditures and other items of a corporation, the uses of funds in a project financing or the purchase of a company, a loan agreement defines various restrictions on uses of cash to pay dividends, subordinated debt and other items. The manner in which a loan agreement establishes priorities in the use of cash flow is sometimes called a cash flow waterfall. A cash flow waterfall is somewhat analogous to multiple hydro plants in a cascade where water is held in reservoirs and allowed to flow down-stream by opening or closing various taps. If reservoirs are full, then the water can be allowed to flow down-stream. On the other hand, if reservoirs are empty, there may be requirements to fill-up the reservoir before any water can be used by subsequent hydro plants in the cascade. A cash flow waterfall that defines the priority of uses of cash is illustrated in the diagram below. For project finance models and acquisition models, modelling the mechanics of cashflow waterfalls that include cash flow sweeps, use and repayment of revolving credit facilities, cash trap covenants, top-ups and with-drawls from a debt service reserve accounts, debt defaults and repayment of defaults as well as interest and repayment of subordinated debt can be intimidating to model, much less analyse in a clear and concise manner.

Exhibit 2-B: Example of Project Flow of Funds

In setting up a cash flow waterfall, you can apply a few ideas and make a seemingly complex waterfall easy to program in a financial model. The general ideas include: first setting up the debt schedule (including debt service reserve accounts); second, structuring the cash flow statement with a whole lot of subtotals; third, separately modelling what happens if cash flow is positive versus what happens when cash flow is negative using the MAX function; fourth assuring that you have not exceeded defined limits of debt using the MIN statement relative to the opening balance or the remaining allowed balance. Application of these four steps includes:

- First, set up the debt schedule and reserve balance schedule with opening balances, prepayments from sweeps, uses of revolving credit, repayments and availability, required balances uses and top-ups of debt service reserve accounts and the balance, debt defaults and repayment of defaults for the defaulted debt. Do not type in excel formulas until all of the cash flow statement is structured.
  - For each item such as cash flow sweeps, defaulted debt, repayment of defaulted debt that comes from the cash flow statement, leave the amount in the debt schedule blank and just enter the title. Amounts from the cash flow statement should all be linked to the debt schedule at the end of the process meaning that all of the formulas to determine how much will be removed or placed in an account is taken from the cash flow analysis. For example, the senior debt schedule may be set up using the following account titles where the pre-payments from the cash sweep come from the cash flow statement:

    Opening balance
    Add: Debt Draws
    Add: Capitalised Interest
    Less: Scheduled Debt Repayments
    Less: Pre-payments from Cash Sweep (Linked to cash flow statement)
    Closing Balance

  - For accounts such as letters of credit and debt service accounts one should set up accounts that track the remaining balance that can be used or the remaining funding that is required in the account. For a letter of credit, the remaining amount that is available for use is the total commitment less the amount that has already been borrowed. For a debt service reserve account, the amount that must be funded is the total required funding less the amount that is already in the account. Setting-up a

letter of credit that can be used to fund deficit cash flow is illustrated below where the borrowings and the repayments come from the cash flow statement:

Total Debt Commitment
Less: Amount Already Borrowed (Opening Balance of Loan)
Remaining Amount to Borrow

Opening Balance of Loan
Add: Amount Borrowed: From Cash Flow Statement
Less: Amount Repaid: From Cash Flow Statement
Closing Balance

- Second, set up the cash flow account titles and the structure of the cash flow waterfall in the model without entering any formulas.

  - In setting up titles include a whole lot of subtotals in the model design – after virtually every element, such as borrowings and paying back the working capital facility, the debt service reserve flows, the debt defaults and repayment of defaults, the cash flow sweep, and the cash trapped by the covenant. The order of priority in terms of which investor receives cash flows should be set-up in a cash flow analysis. An example of setting-up the cash flow analysis with sub-totals with a debt service reserve account, a letter of credit and defaults and a cash flow sweep is illustrated below (in a real model you would not include as much description):

    Operating Cash Flow
    Less: Interest Expense on Senior Debt
    Less: Repayments of Scheduled Debt
    Subtotal 1: Cash Flow after Scheduled Debt Repayment
    Add: With Drawls from DSRA if Cash Flow is Negative
    Less: Top-ups of DSRA if Cash Flow is Positive
    Subtotal 2: Cash Flow after DSRA
    Add: Uses of Letter of Credit if Cash Flow is Negative
    Less: Repayment of Letter of Credit if Cash Flow is Positive
    Subtotal 3: Cash Flow after Letter of Credit
    Add: Defaults on Debt if Cash Flow is Negative
    Less: Repayments if Cash Flow is Positive
    Subtotal 4: Cash Flow after Default
    Less: Cash Flow Sweep if Cash Flow is Positive

  - In setting up titles for a flip structure, it is useful to set-up some supplemental accounts to establish the subtotals as illustrated below:

    Total Cash Flow to Investors
    Cash Flow to Senior Investors before Yield Constraint
    Less: Cash Flow to Senior Investors before Yield Constraint
    Subtotal 1: Cash Flow after Senior Investors before Yield Constraint

    Cash Flow with Yield Constraint/Cash Flow to Senior without Constraint
    Subtotal 2: Cash Flow to Senior Investors after Yield Constraint
    Less: Cash Flow to Senior Investors after Yield Constraint (1-percent) x Total Cash
    Subtotal 3: Cash Flow to Junior Investors

- Third, enter formulas for each step of the cash flow waterfall differently depending on whether the cash flow is positive or negative using a combination of the MAX and MIN functions. As you get used to using the MIN and the MAX functions, you will forget any idea about using IF statements that make the formulas less transparent.
    - Use the MAX(cash flow,0) function to test for positive numbers and use the MAX(-cash flow,0) to test negative numbers. For example, if the cash flow after senior debt service is negative, then you should draw from the revolving credit account and use MAX(-number,0) while if it is positive you should use available cash to repay balances and apply the MAX(number,0) function.
- Fourth, in determining how much cash is available or must be used to pay back items, use the MIN function and test the amount against the opening balance.
    - Virtually all of the calculations in the cash flow waterfall will include both a MIN and a MAX function, but this does not mean that the formulas are too complex. For example, when modelling the amount of cash flow that is borrowed from the letter of credit account, the formula should look something like:
        - MIN(opening balance of available to borrow, MAX(-cash flow,0))
    - If cash flow is positive, then the second component of the formula is zero and the minimum of zero or the balance available will be zero. When the cash flow is positive, then the positive cash flow can be used to repay amounts in the working capital facility as shown in the formula below -- if the opening balance is paid off, then the formula will result in zero as it will if the cash flow is negative:
        - MIN(opening balance of revolving debt, MAX(cash flow,0))
    - In modelling a flip structure, use the MIN command to compare the opening balance of the yield tracking account and the cash flow that would accrue to the senior investors if there was no constraint on the yield. The MIN function combined with the tracking account can be used to find the time at which the yield is realized.
        - MIN(Opening balance of tracking account, cash flow)
- Fifth, link accounts in the cash flow waterfall to the debt schedule.
    - In attaching accounts, the formulas in the debt schedule should be all be simple links, as the evaluations with MAX and MIN formulas have been made in the cash flow analysis. The rule is to keep the formulas in the debt schedule extremely simple.

Revolving Credit Faciliaty								
Commitment	300	300.00	300.00	300.00	300.00	300.00	300.00	300.00
Less: Amount Already Borrowed		-	168.65	300.00	300.00	300.00	300.00	-
Remaing Amount to Borrow		300.00	131.35	-	-	-	-	300.00
Opening Balance		-	168.65	300.00	300.00	300.00	300.00	-
Add: Borrwings		168.65	131.35	-	-	-	-	-
Less: Repayment		-	-	-	-	-	300.00	-
Closing Balance		168.65	300.00	300.00	300.00	300.00	-	-
Interest Rate		5%	7%	6%	6%	7%	2%	0%
Interest Expense		-	11.81	18.00	16.50	21.00	7.06	-
Defaulted Debt								
Opening Balance		-	-	6.82	166.18	275.51	968.08	-
Add: Defaults		-	6.82	159.36	109.33	692.57	-	-
Less: Repayments of Default		-	-	-	-	-	968.08	-
Closing Balance		-	6.82	166.18	275.51	968.08	-	-
Sub Debt								
Opening Balance		100.00	106.67	117.33	129.07	141.97	156.17	-
Add: Interest Capitalised		6.67	10.67	11.73	12.91	14.20	5.25	-
Less: Repayment at Exit		-	-	-	-	-	161.42	-
Closing Balance	100.00	106.67	117.33	129.07	141.97	156.17	-	-

Defaults on Debt and Measuring the Potential Decline in Debt IRR below the Stated Interest Rate

In using a model to assess an investment with debt financing, a useful task is to determine at what point a loss on the loan occurs. When a loss on debt occurs, the interest rate or the IRR realized by lenders is less than promised interest rate and attempts to restructure the debt have not allowed temporary defaults to be repaid. Modelling the point at which defaults on debt occur is useful in credit analysis because one of the objectives of credit analysis is to measure the probability of default as well as the loss given default relative to the credit spread that compensates for risk. Through explicitly modelling defaults, one can analyse at what point the cash flow is insufficient to repay the debt after restructuring. The IRR earned on debt can be computed in a similar manner to the equity IRR where cash outflows made by equity holders are compared to the dividends received in the pockets of the equity holders. In the case of the debt IRR one can measure the cash flow dispersed to lenders and then the debt service received by lenders. Once the realized IRR on debt is computed through accounting for defaults, the risk of debt can be evaluated through break-even analysis, scenario analysis and Monte Carlo simulation. For example, by incorporating defaults on debt in a model, the break-even level of EBITDA can be computed. The probability of achieving this break-even level of EBITDA can then be used to assess the credit spread of the loan.

The process of incorporating defaults into a financial model involves linking the cash flow statement with the debt schedule using the cash flow waterfall concepts discussed above. The amount of defaults is determined in the cash flow statement using a subtotal account. The amount of default that can be repaid is calculated if there is an opening balance in the default account and if the cash flow after other obligations is positive. The following step by step process can works through how to compute the defaults:

Step1: Set up the a debt balance schedule for the defaulted debt with line items that include the opening balance of defaulted debt, the additions to the defaulted balance from defaults, the repayments of default from positive cash flow and the ending balance of defaulted debt.

Step 2: Compute a sub-total cash flow account after the scheduled debt is paid and after all possible other contingent accounts have been used including the debt service reserve accounts, letters of credit and working capital facilities. Compute the defaults in a row below this sub-total when the amount in the sub-total is negative implying that there is an inability to meet debt service. The amount of the default is limited to the amount of debt service that is assumed to be paid and can

be computed using the formula MAX(-cash flow,0) along with a MIN function that limits the default to the total debt service. The following formula represents computation of the defaults on debt:

Default = MIN(debt service, MAX(-cash flow,0)

Step 3: Link the defaults in debt to the defaulted debt schedule. As for other items in the cash flow waterfall such as the debt service reserve account and letters of credit, calculations of cash flow movements should be made in the cash flow statement where they can be directly to subtotals and the only formula in the defaulted debt schedule should be a link.

Step 4: Below the debt defaulted row in the cash flow statement, set-up as line for the re-payment of default. The repayment of default is a function of the cash flow and the amount of debt default. Repayment of cash flow only occurs when the cash flow is positive meaning an MAX function should be used. The repayment of default cannot be above the total amount of the defaulted which means it should be capped by the opening balance of the defaulted debt. This means the defaulted debt is the minimum of the positive cash flow or the opening balance of the defaulted debt as shown in the formula below. Once the repayment of the default is computed in the cash flow waterfall using the formula above, link the repayment of default to the debt schedule.

MIN(opening balance of defaulted debt, MAX(cash flow,0))

Step 5: Compute the cash flow realized by lenders for purpose of computing the debt IRR and the debt NPV through deducting defaults and adding re-payment of defaults to the scheduled debt service. The debt cash flow is demonstrated in the following formula:

Debt cash flow = Interest paid + repayments – defaults + repayment of default – cash debt invested

A diagram that is intended to illustrate the link between the cash flow statement and the debt balance is presented below. The diagram below illustrates that the default comes from the cash flow statement, the repayment of default comes from the earlier default, and the repayment of default is put back into the cash flow statement.

Including Subordinated Debt with the Ability to Assess Risk and Return Characteristics of Subordinated Debt Relative to Senior Debt

The most basic issue in finance is assessing risks and returns from an investment. This issue is highlighted in analysis of subordinated debt where the higher credit spread on subordinated debt must be evaluated relative to the higher risk of subordinated debt relative to senior debt. To evaluate the risk of subordinated debt, a financial model much be able to determine the point at which the loss occurs and the risk and return characteristics of the subordinated debt. In modelling subordinated debt, the first step is to include the debt in the sources and uses analysis. When developing the subordinated debt schedule, it is possible that interest is capitalized and added to the balance of the debt. In the final period when the subordinated debt matures, the amount of the debt repayment is the sum of the opening debt balance and the interest capitalized for the final year.

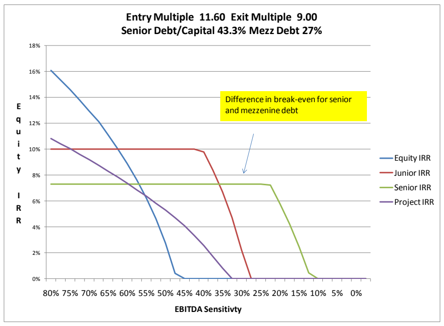
Once the debt schedule is established for subordinated debt, the cash flow statement must reflect the priority of the subordinated debt relative to other debt service. If debt with differing priority is included in the cash flow statement, then a cash flow waterfall should be modelled that reflects the specific provisions including the interest, repayment of debt service, covenants and sweeps of the alternative debt. When structuring the cash flow statement with alternative priorities, it is essential that the ordering of titles in the cash flow analysis conform the ordering of cash flows in the loan documents. For example, if there is a cash flow sweep for senior debt and junior debt interest is not capitalized, then the senior debt sweep must occur after the junior debt interest payments.

To illustrate how a model can be used to assess the risk of senior versus subordinated debt, a sensitivity analysis can be performed of the EBITDA in terms of senior IRR, subordinated IRR, equity IRR and the

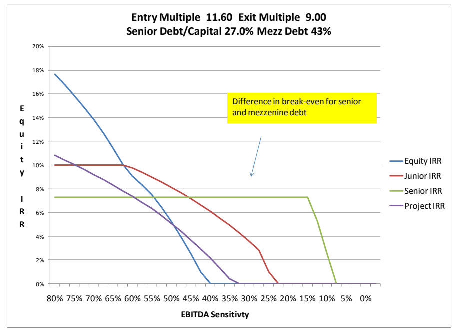
overall project IRR. The difference in points at which the senior IRR and the junior IRR crosses is a measure of the risk. In the diagram below the case with more subordinated debt has more risk as demonstrated by the break-even points.

IRR on Senior versus Junior Debt with Different Capital Structures

- More Senior Debt



- More Subordinated Debt



Chapter 10: Alternative Calculations of How Different Shareholders are given Cash Flow -- Flips, Earn Outs and Management Incentives

Shareholder agreements or partnership agreements may define the manner in which senior investors receive a priority on cash flow available after debt in an analogous manner to the way in which loan agreements define priorities on cash flow before equity distributions. Some agreements may distribute dividends using complex formulas rather than simply allocating common dividends in a proportionate all shareholders. These structures can involve a flip where one group of shareholders is allocated the majority of dividends until a given IRR criteria is met. After achieving the IRR target, the dividend distribution scheme changes and the second investor receives a majority of the dividends. Other structures can allocate upside to management or to developers after some criteria is met. For example, management may receive 10% of the excess cash flow after a given IRR is obtained. Finally in acquisition transactions, earn out provisions can be established whereby a portion of the purchase price is allocated to existing owners, but they are only allowed to share in upside profits after a certain target is obtained.

The cash flow sharing that is part of shareholder agreements is analogous to cash flow waterfall applied to equity cash flow. In modelling a cash flow waterfall applied to equity distributions, the formula for receiving the dividends must be understood as is the case for priorities in the debt waterfall. If dividends are not distributed in a proportional manner, there must be some kind of trigger mechanism or formula that changes the distribution among investors. Some of the investors receive an implicit priority on cash flow either through a shareholder loan or the right to a higher proportion of dividends before some kind of target is met. As with the debt waterfall, the investor that has the highest priority claims on cash flow should be modelled in an analogous manner to the senior debt. Complexity in modelling the equity cash flows can arise if the criterion is based on an IRR limit as described above. One could compute a rolling IRR, but then one would have to allocate cash in the period in which the target IRR is obtained. In this period when the IRR has just been achieved, some of the cash flow is allocated to one investor and some is allocated to a second investor. To model a flip structure the following process can be developed:

First, set-up an equity tracking account (somewhat analogous to a debt balance account) that reaches a level of zero once the IRR target is achieved.

Second, set-up the cash flow statement titles in order of the claims where the senior claim to the equity cash flow is listed first.

Third, after the first tranche is computed, distribute the income according to percentages.

A yield tracking account should be created when modelling a flip structure where a senior investor receives a proportion of cash flows until an IRR yield is met, and a second investor receives the remainder of the cash and a different proportion after the yield is reached. The yield tracking account keeps track of the balance due to the senior after taking account of the earnings that must be realized for the yield to be met. The tracking account is similar to the other accounts except that the opening balance is increased by the yield that must be earned as illustrated below:

Opening Balance
Add: Earnings on Investment (Opening Balance x Required Yield)
Sub-total
Less: Dividends Distributed to Senior Partner
Closing Balance

In this account, the dividends cannot exceed the sub-total balance as the yield will be exceeded. To cap the dividends at the sub-total, the distributed dividends can be computed as: MIN(-subtotal, dividend formula)

Chapter 11: The Last Step in Creating a Financial Model -- Putting Together Financial Statements and Tricky Issues in Calculating Income Taxes

Once a working module that computes revenues, expenses and working capital is established along with the depreciation schedule and the debt schedule, the profit and loss statement should be simple to calculate. In a corporate model, the net income defines the earnings per share. For a project finance model, calculation of taxes from the profit and loss statement is required to develop taxes. The EBTIDA is given by the revenues and cash operating expenses on the income statement. Depreciation and amortization (DA) from the fixed asset module is then subtracted resulting in EBIT. After computing EBIT, interest expense is subtracted and interest income is added resulting in EBT. The interest expense and interest income is taken from the debt schedule. With EBT established, book taxes – the single calculation in the profit and loss statement that is not a subtotal -- are computed through multiplying the EBT by the tax rates and subtracting minority interest overall earnings can be computed.

Cash taxes are a somewhat more difficult than deriving book profit, although the calculation is not too painful if taxes are structured properly when setting-up a model. The computation of taxes can have an important effect on capital intensive projects such as renewable energy projects where rapid tax depreciation may be allowed, but the taxable income is not sufficient to use all of the tax deductions (including high levels of interest expense at the beginning of the modelling period.) As with the other mechanical issues regarding construction of a model one of the most important elements is simply not to be afraid to either read or construct the tax section of models. An effective way to compute taxes paid is to add a separate tax schedule that lays out the taxes paid from a net operating loss carryforward analysis. Incorrect computation of taxes paid and simplistic accounting for taxes can cause major problems in measurement of cash flow and valuation.

Computation of Taxes Paid and Taxes Deferred

A modelling process that will model taxes is to first compute the taxes on the books and the cash taxes actually paid. After the income statement is completed, the EBT from the income statement can be used

as the first item of cash tax analysis. From the EBT, adjustments can be made that convert the EBT for books into the EBT for taxes. One of these adjustments involves adding back book depreciation and then deducting tax depreciation. Once the adjustments are made, the taxable income for purposes of computing cash taxes can be computed. After the taxable income is derived, adjustments for a net operating loss carry forward can be made. This involves determining the balance of the net operating loss and making adjustments that increase or decrease the carry forward balance. Once the cash taxes are established, the change in deferred taxes can be calculated along with the accumulated deferred tax. To compute the taxes paid and the taxes deferred, one can following the following step by step process in a module below the income statement.

Step 1: Create a row that repeats the EBT from the income statement.
Step 2: Adjust the book EBT for depreciation and other items that cause cash taxes to differ from the taxes reported on the book profit and loss statement.
Step 3: Set-up an account that maintains the net operating loss balance including the opening balance, the additions that occur when there is negative taxable income and the deductions that occur when the net operating loss is used to reduce taxes that would otherwise be paid when there is taxable income.
Step 4: Compute the amounts deposited into the account from negative taxes through converting the negative amounts into positive numbers. As with the cash flow waterfall, use the MAX function to convert negative numbers into positive numbers and cap the negative numbers at zero.
Step 5: Calculate the amounts removed from the operating loss balance through determining the minimum of the opening balance and taxable income. This is again similar to the cash flow waterfall where MIN and the MAX functions are used together – the MIN function limits the use to the taxable income or the opening NOL balance.
Step 6: Compute the adjusted taxable income after adjusting for inflows and outflows from the operating loss account.
Step 7: Multiply the adjusted taxable income by the statutory tax rate to determine the cash taxes.
Step 8: Subtract the book taxes from the cash taxes to determine the change in accumulated deferred taxes.
Step 9: Accumulate the deferred taxes through adding the changes in deferred taxes to the prior years balance. If the accumulated deferred taxes are positive, put the balance on the liability side of the balance sheet and if they are negative, change the sign and put the account on the asset side of the balance sheet.

	1	2	3	4	5	6	7
EBT - Book	(500.0)	(300.0)	100.0	200.0	300.0	400.0	500.0
Tax Expense	(137.5)	(82.5)	27.5	55.0	82.5	110.0	137.5
Net Income	(362.5)	(217.5)	72.5	145.0	217.5	290.0	362.5
EBT - Book	(500.0)	(300.0)	100.0	200.0	300.0	400.0	500.0
Less: Added Dep for Tax	100.0	100.0	100.0	(100.0)	(100.0)	(100.0)	
EBT - Tax	(600.0)	(400.0)	-	300.0	400.0	500.0	500.0
NOL							
Opening Bal	-	600.0	1,000.0	1,000.0	700.0	300.0	-
Add: Tax Losses	600.0	400.0	-	-	-	-	-
Less: Used NOL	-	-	-	300.0	400.0	300.0	-
Closing Balance	600.0	1,000.0	1,000.0	700.0	300.0	-	-
Taxes w/o NOL	(165.0)	(110.0)	-	82.5	110.0	137.5	137.5
Add: NOL Inflows	165.0	110.0	-	-	-	-	-
Less: Outflows	-	-	-	82.5	110.0	82.5	-
Taxes Paid	-	-	-	-	-	55.0	137.5
Deferred Tax	(137.5)	(82.5)	27.5	55.0	82.5	55.0	-
Accumulated Deferred Tax	(137.5)	(220.0)	(192.5)	(137.5)	(55.0)	-	-

If the tax law includes provisions whereby NOL can be lost after a certain period of time, the calculations become more complex. The problem is that one needs to look backwards to find when the NOL is lost and more importantly, the losses do not include NOL balances that have already been used. To compute

a more complex NOL calculation, the OFFSET function can be used along with a balance that maintains the accumulated NOL's that have already been used. The OFFSET can be used with a row and column indicator to compute the maximum amount that can be lost which is the amount that was created in the lagged year. The amount of NOL used is then accumulated and reduced using the MIN function as shown below.

Tax Rate	20%												
Carryforward period	3												
	1	2	3	4	5	6	7	8	9	10	11	12	13
EBT	200	-200	-300	100	-10	50	20	-20	-50	10	15	20	15
NOL Balance													
Opening Balance	-	-	200.0	500.0	400.0	310.0	-	-	20.0	70.0	60.0	35.0	-
Less: NOL Lost	-	-	-	-	100.0	300.0	-	-	-	-	10.0	35.0	-
Remaining NOL	-	-	200.0	500.0	300.0	10.0	-	-	20.0	70.0	50.0	-	-
Add: Losses	-	200.0	300.0	-	10.0	-	-	20.0	50.0	-	-	-	-
Less: NOL Used	-	-	-	100.0	-	10.0	-	-	-	10.0	15.0	-	-
Closing Balance	-	200.0	500.0	400.0	310.0	-	-	20.0	70.0	60.0	35.0	-	-
Switch	FALSE	FALSE	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
NOL from Lagged Period	-	-	-	-	200.0	300.0	-	10.0	-	-	20.0	50.0	-
Amonunt Used													
Opening Balance	-	-	-	-	100.0	-	10.0	10.0	-	-	10.0	15.0	-
Add: Used from above	-	-	-	100.0	-	10.0	-	-	-	10.0	15.0	-	-
Less: Expired with MIN	-	-	-	-	100.0	-	-	10.0	-	-	10.0	15.0	-
Closing Balance	-	-	-	100.0	-	10.0	10.0	-	-	10.0	15.0	-	-
Amount Lost (Lagged - Expired)	-	-	-	-	100.0	300.0	-	-	-	-	10.0	35.0	-
Adjusted EBT	200.0	-	-	-	-	40.0	20.0	-	-	-	-	20.0	15.0
Taxes	40.0	-	-	-	-	8.0	4.0	-	-	-	-	4.0	3.0

Cash Flow Statement and Balance Sheet

The structure of all of the financial model types includes a cash flow statement and a balance sheet as the final part of the model structure. Complicated issues associated with the cash flow statement were discussed above in the context of the cash flow waterfall and the cash flow statement should have a similar presentation to the cash flow waterfall. Other than the cash flow waterfall, programming the cash flow statement and the balance sheet simply involves linking the rows with other calculations that have already been made. The only calculation that is not a simple sub-total in a cash flow statement is for dividends. A separate section is included for these parts of the model in order to be comprehensive and because of the importance of structuring the sheet.

Most of the time it is better to begin a cash flow statement with revenues, expenses and EBITDA rather than net income. If net income is the starting point, then interest expense and interest income are already included in net income. To compute a cash flow waterfall, the senior interest may have to be separated from subordinated interest expense and interest income generally is available for cash flow. Other than the MIN and MAX statements that are used to define the cash flow priorities every item on the cash flow is either a sub-total or directly comes from the debt schedule, the income statement, the working capital module and other places. The end of the cash flow statement is different depending on the type of model. For corporate models and integrated models, the dividends are included in the financing section of the model and the end of the cash flow statement is surplus or deficit cash flow that feeds into the short-term debt and the surplus cash. In the case of project finance models and acquisition models, changes in cash are included as required reserve accounts such as the debt service reserve account and the last line is the dividend distribution.

Other than the model outputs and the risk analysis, the last part of a model is computation of the balance sheet. For people who have done a lot of modelling, seeing the balance sheet balance is a wonderful feeling. To the contrary, not being able to find where the balance sheet has gone wrong is a nightmare. For the balance sheet to be an effective auditing tool, each item in the balance sheet should be already computed in the model and you should simply find all of the closing balances and link them to the balance sheet. The balance of accounts receivable, cash, plant, debt should already exist. For other assets on

the balance sheet that are not modelled in detail such as investments, debt issuance cost associated with capitalized underwriting fees and operating reserve accounts, balances should be established. A separate account can be created for the book balance of assets and the tax balance of assets if there is a difference in depreciation methods or in the basis for depreciation. The balance of equity capital that includes the effects of net income and dividends should be presented before the balance sheet but after the cash flow statement. A similar presentation should be made for minority interest which derives items from the balance sheet and the cash flow statement.

Chapter 12: Advanced Issues in Corporate and Acquisition Modelling Involving Resolving Circular References Associated with Interest Expense and Debt Repayments

Circular References in Corporate and Acquisition Models

One issue that not too many people in the world care about is coming up with an elegant way to compute the interest expense and/or interest income on the average of opening and closing debt or cash balances in financial models without using the iteration button in excel and without using a macro. While the problem may be trivial to most people and is certainly not a key driver of any analysis (it is fine to use the opening balance in general), solving the problem illustrates elegant ways in which functions can be used with conditional statements and iterations in financial models. For advanced modelling problems, using functions opens a whole new world of solving problems that typically use tedious copy and paste macros. Resolving the problem is particularly tricky when there is the possibility of a net operating tax loss that is carried forward and when the interest income rate on surplus cash is different from the interest expense rate on debt.

In describing how to solve the problem of circular references and other challenging problems in modelling, it is best to begin with a simple problem and gradually add complexities until you get completely stuck. The organisation of this chapter follows such an approach in describing how to resolve the circular reference problem. An acquisition model with a cash flow waterfall without taxes is the starting point for the analysis. This case is relatively simple because there is no difference in interest rates between surplus cash earnings and interest expense. Further, there is no effect of the interest expense on taxes and on dividend payouts. Taxes (particularly with net operating losses), differences between interest income and interest expense rates and dividends (especially with limits when earnings are negative) complicate the problem immensely.

Corporate models and acquisition annual models are often annual models were the assumption of incremental interest expense or incremental interest income on the basis of the opening balance is not reasonable. If the opening balance is used for interest expense on new debt or interest income on new surplus cash generated, the implicit assumption is that all revenues received and all expenses and capital expenditures incurred are at the end of the year. Making an assumption that the revenues occur in the middle of the period which is much more reasonable creates a circular reference because the closing balance of the debt or cash affects the interest expense. But the interest expense is a determinant of cash flow that drives the closing balance as illustrated below:

Closing Balance	→	Interest Expense
Interest Expense	→	Net Cash Flow
Net Cash Flow	→	Closing Balance

Some people suggest that from a philosophical standpoint that circularity should not occur in the models because it does not occur in real situations. For example, if circularity existed in financing a transaction, the process would work something like the following. The sponsor would go to the bank and ask for a loan commitment. Then, the bank uses the amount of the loan commitment to compute fees. After that, the sponsor asks for a larger loan to cover the fees that were not known before he asked the bank for the

loan. With the larger loan, more fees are charged and the sponsor needs an even higher loan. Then the loan is higher and process keeps going on and on and on. The circular reference resembles the film “Groundhog Day” where life cannot move forward and the same problems occur again and again and again. Instead of the above scenario with the banker and the sponsor going around, it is more realistic if the sponsor asks for a loan commitment that will already include the fees, the debt service reserve account, and the interest during construction that can cause a circular reference problem. When a company goes to a bank to ask for a loan in a project financing transaction, the company has already created a model and evaluated the sizing of debt, presumably through evaluating the debt service coverage or some other criteria. This is the philosophy that circular references should not be in a model. Notwithstanding philosophical considerations about whether circular references occur in the real world, various combinations of the funding approaches cannot be solved without running into a circular reference problem where the debt or equity commitment drives the total funding needs and when the funding needs drive the financing commitment. From a modelling standpoint, the fees and the loan commitment depend on the financial model, but the model must be computed with some kind of fee and debt commitment assumption. When an item in the model depends on using the model itself, a circular reference sometimes cannot be avoided.

Circular References using Copy and Paste Macros

There are various ways to resolve the circular references without using the iteration button, but solutions that use macros can create new problems and be worse than the original problem. One well known approach is to use a copy and paste macro using the following steps:

Step 1: Make sure there are two calculations of the thing that is causing the circularity (e.g. interest expense computed in the profit and loss statement and interest expense calculated in the debt schedule).

Step 2: Compute the year by year difference between the two calculations and then sum all of the differences.

Step 3: Record a macro and then copy and paste special as values from one of the rows to the other. For example, in the case of interest expense, copy the interest expense line below the debt schedule and paste it special to the income statement.

Step 4: Modify the macro to include a while and end loop that continues until that sum of the differences equals zero as illustrated below.

```
While Range(“sum_of_difference”) <> 0

    Copy and paste special interest expense from debt schedule to profit and loss statement

Wend
```

Fancier ways to add bells and whistles to copy and paste macros (adding iteration limits, displaying the iterations and simplifying the code) are described below in the context of project finance analysis.

Basic Circular References in with Cash Sweeps in Acquisition Models using Functions

A more elegant solution to the problem of circular references than using macros or allowing the iteration button to be active is to create a function that derives the interest expense from an algebraic expression. The algebraic solution is complicated by taxes, dividends and variations in interest rates between income and expense. To begin the discussion, consider an acquisition model where all excess cash flow is used to pay down debt before any dividends are allowed (a cash flow sweep). Further assume no taxes. In this case the repayment of debt can be computed in the cash flow statement using the MIN function consistent with the discussion of cash flow waterfalls above:

Repayment = MIN(Cash after Interest, Opening Balance of Debt)

When working through the circular reference functions, it is generally best to solve for the repayment. You can then replace the cash after interest in the above equation with a repayment function. In the simple example explained below with no taxes and a cash sweep, the arguments for the function are the operating cash flow (EBITDA less working capital changes and capital expenditures.) Assuming the function created is named SWEEP, the repayment equation is replaced with the following function:

Repayment = MIN(SWEEP(operating cash flow, interest rate), Opening Balance of Debt)

In creating the function, begin by writing down a couple of equations that define interest expense and the repayment of debt assuming that the interest is derived from the average balance rather than the opening balance:

Interest Expense = Opening Balance x Interest Rate – Repayment x Interest Rate /2

Repayment = MIN(Cash flow, Opening Balance)

Cash Flow = Operating Cash Flow – Interest Expense

Using these equations, you can create and expression for the repayment by simply using a few substitutions. In general the method is to attempt to find the equation for repayment and replace the cash flow equation with a repayment equation as illustrated below:

Repayment = Operating Cash Flow – (Opening Balance x Interest Rate – Repayment x Interest Rate/2)

Repayment + Repayment x Interest Rate/2 = Operating Cash Flow – Opening Balance x Interest Rate

Repayment x (1 + Interest Rate/2) = Operating Cash Flow – Opening Balance x Interest Rate

Repayment = (Operating Cash Flow – Opening Balance x Interest Rate) / (1 + Interest Rate/2)

You can put this equation into a function named SWEEP and then combine the function with the MIN function as illustrated below:

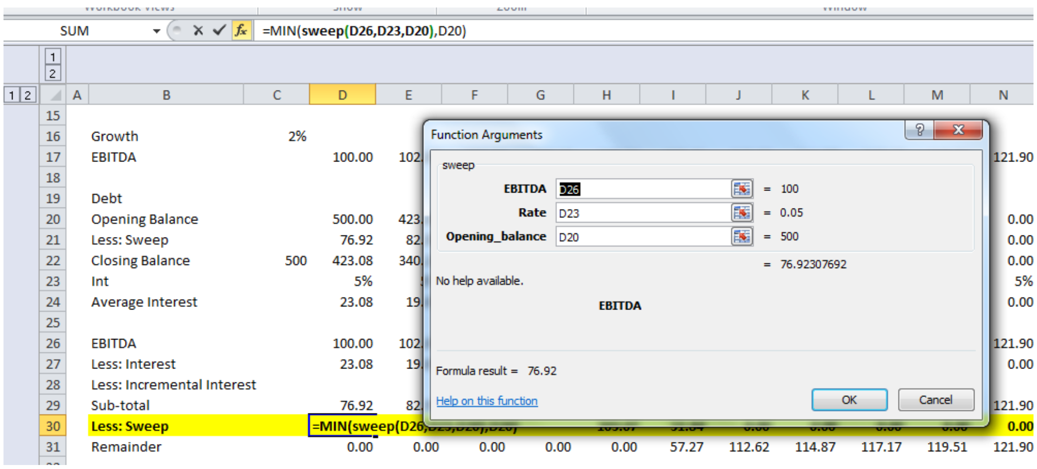
```
Function sweep(EBITDA, rate, Opening_balance)

sweep = (EBITDA - Opening_balance * rate) / (1 - rate / 2)

End Function
```

Growth	2%											
EBITDA		100.00	102.00	104.04	106.12	108.24	110.41	112.62	114.87	117.17	119.51	121.90
Debt												
Opening Balance		500.00	423.08	340.16	250.89	154.92	51.84	0.00	0.00	0.00	0.00	0.00
Less: Sweep		76.92	82.92	89.26	95.98	103.07	51.84	0.00	0.00	0.00	0.00	0.00
Closing Balance	500	423.08	340.16	250.89	154.92	51.84	0.00	0.00	0.00	0.00	0.00	0.00
Int		5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Average Interest		23.08	19.08	14.78	10.15	5.17	1.30	0.00	0.00	0.00	0.00	0.00
EBITDA		100.00	102.00	104.04	106.12	108.24	110.41	112.62	114.87	117.17	119.51	121.90
Less: Interest		23.08	19.08	14.78	10.15	5.17	1.30	0.00	0.00	0.00	0.00	0.00
Less: Incremental Interest												
Sub-total		76.92	82.92	89.26	95.98	103.07	109.11	112.62	114.87	117.17	119.51	121.90
Less: Sweep		=MIN(sweep(D26,D23,D20),D20)				**103.07**	**51.84**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Remainder		0.00	0.00	0.00	0.00	0.00	57.27	112.62	114.87	117.17	119.51	121.90

In entering the function, you can use the f_x box to guide the inputs to put into the formula as illustrated below:



Solving Circular References with Taxes in Acquisition Models

When adding taxes into the acquisition model, the equations become more tedious, but the principle is the same unless the effective tax rate changes because of a net operating loss carryforward. The bad news about more tedious formulas is that they are painful and sometimes boring to work through. The good news is that if you create a function and use variable names that are easy to interpret, you only have to do it one time. Once you have made the function, you can copy the function to other functions or even create an add-in to excel. The formulas are generally easy to transfer because by the time you get down to an income statement and a cash flow statement in a financial model, the format should be almost identical.

The problem with taxes is that interest expense affects taxes which implies that taxes cannot be included as a component of cash flow like capital expenditures and working capital changes which were deducted in computing operating cash flow. Further, since depreciation expense shields taxes, it must be included in the equation for taxes and entered as an input to the function. The process of incorporating taxes in the repayment function is illustrated below:

Taxes = (EBITDA – Depreciation – Interest) x Tax Rate
Operating Cash Flow = EBITDA – Cap Exp – WC changes – Taxes

Interest Expense = Opening Balance x Interest Rate – Repayment x Interest Rate /2

Repayment = MIN(Cash flow, Opening Balance)
Repayment = Cash Flow = Operating Cash Flow – Interest Expense

When substituting, the equations become more tedious, but it is easy to demonstrate that the repayment equation includes the depreciation and the tax rate. Further, the capital expenditures and the working capital changes must be differentiated from EBITDA because there is no tax deduction associated with these items. In creating the equation, the opening balance of the debt multiplied by the interest rate is labelled the opening interest to make the formulas somewhat smaller.

Sweep = [EBITDA * (1 - t) - WC - CapExp + Dep * t + Open Int * (t - 1)]/(1 - rate/2 + rate/2 * t)

Once this equation is created, it can be added to an acquisition model in the same way as the simpler equation as illustrated above.

This equation is relatively straightforward but it does not work if there are net operating tax losses. With tax operating losses, the effective tax rate changes and the effective tax rate is a function of cash flow and interest expense itself. Further, as explained above in the general discussion of net operating losses, the net operating loss cannot be boiled down to a simple linear equation as one must keep track of losses from earlier years. Since net operating loss carryforward calculations can have important effects on the value of a transaction, if you cannot model net operating loss tax carryforward calculations because of resolving the circular reference problem, then you might as well go back to one of the other techniques such as using the opening balance. The good news is that you can incorporate changing tax rates caused by net operating losses in the function. To do this, you can put the equations for the net operating loss in the function, re-calculate taxes paid, compute the effective tax rate and use the new effective tax rate in the repayment function above. As the repayment and resulting interest expense can affect the net operating loss calculations, you can iterate around the repayment calculation in the function (you cannot however refer to ranges in the spreadsheet that are affected by the calculation such as a effective tax rate). The general approach is illustrated below:

Step 1: Read in variables to the function including opening balance of the net operating loss carryforward and opening interest expense

Step 2: Establish a counter variable for testing the number of iterations

Step 3: Compute the balance of the net operating loss and the effective tax rate using the opening interest expense

Step 4: Calculate the debt repayment using the formula above and then compute the interest expense

Step 5: If the counter variable is less than two then go back to step 3 and re-compute the net operating loss and the effective tax rate.

A function that implements this approach is illustrated below. Note that the number of iterations can be very small and with this function there is no pressing of a macro button, no mysterious calculations, no limitation on using the goal seek function and other problems that arise with the copy and paste macro approach.

```
iter = 1
re_start:
iter = iter + 1
'
' re-compute Adjusted EBT and Effective tax Rate
'
EBT = EBITDA - depr - Int1 - incr_int
Loss = WorksheetFunction.Max(-EBT, 0)
min_use = WorksheetFunction.Min(OB, EBT)
use = WorksheetFunction.Max(min_use, 0)
```

```
EBT_Adj = EBT + Loss - use
taxes_paid = EBT_Adj * t
eff_t = taxes_paid / EBT
'
' commpute the repayment with the effective tax rate and the new interest expense
'
sweep_nol = (EBITDA * (1 - eff_t) + depr * eff_t + Int1 * (eff_t - 1)) / ((1 - (rate1 / 2) + (rate1 / 2) * eff_t))

incr_int = 0 - sweep_nol * rate1 / 2

If iter < 3 Then GoTo re_start
```

Solving Circular References in Corporate Models

If the process of incorporating the net operating loss into an acquisition model with a cash flow sweep was not bad enough, the formulas are even more tedious and there are more iterative adjustments when solving the problem for a corporate model. Added complexities in the corporate model arise from differences between the interest income rate and the interest expense rate and because dividends may be incorporated in the model where they are a function of the income which in turn is driven by interest income and interest expense. The good news is that it is possible to solve the problem and as stated above, after you have done it one time, you can use the function over and over again in other models. Before beginning the discussion of the formulas and iterative procedures in functions the structure of a corporate model should be addressed. Because of the different treatment of interest income and interest expense it is good not to lump the surplus cash and short-term debt together as described above, but instead maintain separate accounts. Further, the account for required operating cash should be segregated as should other existing debt and exiting instruments that create income such as notes receivable. When the surplus cash and the short-term debt are added as separate accounts, the end of the cash flow statement resembles a cash flow waterfall. If the cash flow is positive, then short-term debt is first paid off followed by increasing the surplus cash. If the cash flow is negative, then surplus cash is used first followed by issuing more debt. As with the cash flow waterfall process described above, the MAX function is used to test whether an item is positive or negative and the MIN function is used to cap or limit an item. The cash flow process at the bottom of a corporate model cash flow statement can be represented by the following step by step process:

Step 1: Compute the cash flow after dividends as described above. The remaining amount will affect the operating cash balance, the changes in the surplus cash and the changes in the short-term debt balance.

Step 2: Subtract the required cash for operations from an analysis of the level of revenues relative to the amount of cash required. This does not cause any circular reference.

Step 3: Compute the remaining cash flow. If this line is computed from a function, then the circular reference can be broken. This line is divided into the remaining rows through using MIN and MAX functions.

Step 4: If the cash flow is negative, remove money from the surplus cash account. Use the MAX(-cash flow, 0) function to test whether the function is negative and then compare the amount of the cash flow removed with the opening balance of the account using the MIN function:

Reduction in Surplus Cash = MIN(MAX(-cash flow,0),opening surplus cash)

Step 5: If the cash flow is positive, then put remove money from the debt balance account as long as the opening balance has a positive balance. As described in the cash flow waterfall chapter, the MAX and MIN functions can be used again. This time the functions are:

Reduction in Short-term Debt = MIN(MAX(cash flow,0), opening debt balance)

Step 6: Compute a sub-total as explained in the general discussion of cash flow waterfalls so that you can determine how much to add to the surplus cash account if the remaining cash is positive and how much you need to add to the debt account when the remaining cash is negative.

Step 7: Use the MAX functions for the final two lines, but test for a negative cash flow to determine how much debt to add and test for positive cash flow to test for how much cash to add:

Increase in Cash = MAX(cash flow subtotal,0)

Increase in Debt = MAX(-cash flow subtotal,0)

The format of such a cash flow waterfall at the end of the corporate model is illustrated below.

Cash Flow Statement

EBITDA		36.00	43.20	51.84	62.21	74.65	89.58	107.50	128.99	154.79
Less: WC Changes		-	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Less: Capital Expenditures		-	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Less: Taxes Paid		-	-	-	-	-	-	-	-	-
Cash Flow from Operations		36.00	-6.80	1.84	12.21	24.65	39.58	57.50	78.99	104.79
Less: Interest Expense on New Debt		9.25	8.50	8.50	8.40	7.87	6.65	4.56	1.64	-
Less: Other Interest Expense		-	-	-	-	-	-	-	-	-
Add: Interest Income on Operating Cash		0.21	0.24	0.29	0.34	0.41	0.49	0.59	0.71	0.85
Add: Interest Income on Surplus Cash		3.75	3.58	3.34	3.27	3.27	3.27	3.27	3.39	4.79
Less: Dividends	0%	-	-	-	-	-	-	-	-	-
Cash Flow after Dividends		30.71	-11.49	-3.04	7.42	20.46	36.69	56.80	81.46	110.44
Less: Required Cash for Operations		0.80	2.16	2.59	3.11	3.73	4.48	5.37	6.45	7.74
Remaining Cash Flow		29.91	-13.65	-5.63	4.31	16.72	32.21	51.42	75.01	102.70
Add: Withdrawl from Surplus Cash when Negative		-	13.65	5.63	-	-	-	-	-	-
Less: Reduction from Short-term Debt when Positive		29.91	-	-	4.31	16.72	32.21	51.42	65.42	-
Remaining Cash Flow		-	-	-	-	-	-	-	9.58	102.70
Add: Issuance of New Debt when Negative		-	-	-	-	-	-	-	-	-
Less: Addition to Cash Balance when Positive		-	-	-	-	-	-	-	9.58	102.70
Remainder		-	-	-	-	-	-	-	-	-

The trick in taking circular references out of this process is to compute the first remaining cash flow line with a function. This is like cutting all of the blue arrows which appear in excel after you enter a circular reference. The problem with breaking this circular reference with a function is that the interest rate on surplus cash differs from the interest rate on new short-term debt and these amounts depend on how the remaining positive or negative cash is distributed. To resolve the remaining cash flow, first assume that you knew the weighted average interest rate and then use an algebraic expression using the weighted average interest rate. In a simple case without dividends and without taxes, the process of computing the weighted average interest rate for use in the key cash flow line item is illustrated using the step by step process below:

Step 1: Read in variables for the interest income rate, the interest expense rate and the operating cash flow.

Step 2: Make an initial calculation of the average interest rate assuming that the surplus cash and the short-term debt balance are equal.

Step 3: Compute the repayment line with an algebraic expression shown below

Step 4: If the cash flow is negative, compute the reduction in surplus cash and use the MIN and MAX functions in the evaluate how much of the negative cash flow is applied to surplus cash and how much is applied to short-term debt. This involves repeating the steps above where the MIN function is used to test how much surplus cash can be applied and results in computing the weighting for short-term debt and surplus cash.

Step 5: If the cash flow is positive, compute the reduction in new debt and use the MIN and MAX function to evaluate how much of the positive cash flow is applied to debt reduction and how much is applied to building up of cash. This again involves using the MIN function and computing the weighting for surplus cash and short-term debt.

Step 6: Using the new weightings for short-term debt and cash go to step 3 above and re-do the process as the average interest rate affects the calculation of the repayment and the remaining weighted average calculations. You only need to allow one or two iterations before the average interest rate will quickly resolve.

The computation of remaining cash flow using an algebraic formula uses the same concept above for the cash flow sweep once the average interest rate is established. The remaining cash flow depends on the average interest expense or income but the average interest expense or interest income depends on the remaining cash flow. In simple case with no capital expenditures, working capital changes, taxes or dividends, and where interest on long-term debt, operating cash balances the opening balance of surplus cash and the opening balance of short-term debt is labelled fixed interest income or fixed interest expense, the cash flow can be resolved as follows:

CF = EBITDA – Interest Expense + Interest Income

Interest Expense = Fixed Interest - Interest Rate x Cash Flow
Interest Income = Fixed Income + Interest Income Rate x Cash Flow
Incremental Interest Expense and Income = Weighted Average Rate x CF

Substituting:

CF = EBITDA - Fixed Interest + Fixed Income + Weighted Average Rate x CF

CF = (EBITDA – Fixed Interest + Fixed Income)/(1-Weighted Average Rate)

Using this equation, the function below illustrates how to compute the weighted average interest rate using an iteration technique where the weighted average debt and the weighted average surplus cash are derived:

```
Function corp_cf(EBITDA_less_capexp_wc, interest_expense_opening, interest_income_opening, interest_rate, interest_income_rate, interest_income_cash, operating_cash_change, opening_debt_balance, opening_cash_balance)

EBITDA = EBITDA_less_capexp_wc

Iteration = 1

average_rate = (interest_income_rate + interest_rate) / 2

re_start:

corp_cf = (EBITDA - interest_expense_opening + interest_income_opening + interest_income_cash - operating_cash_change) / (1 - average_rate / 2)

Iteration = Iteration + 1
'
' Positive cash and first pay down debt
'
If corp_cf > 0 Then
   debt_percent = WorksheetFunction.Min(corp_cf, opening_debt_balance) / corp_cf
   cash_percent = 1 - debt_percent
   average_rate = debt_percent * interest_rate + cash_percent * interest_income_rate
End If

If corp_cf < 0 Then
```

```
    cash_percent = WorksheetFunction.Min(0 - corp_cf, opening_cash_balance) / (0 - corp_cf)
    debt_percent = 1 - cash_percent
    average_rate = debt_percent * interest_rate + cash_percent * interest_income_rate
End If

If Iteration < 3 Then GoTo re_start:


End Function
```

Solving Circular References in Corporate Models with Income Taxes and Dividends

The final issues involve adding taxes and dividends to the corporate model. There is nothing new from adding these items except that the equations are more tedious and that additional iterations are needed to make sure that neither the taxes nor the dividends are negative. After you have developed this function one time, you should be able to apply it to all of your corporate models and you can make the process less tedious by aggregating the fixed interest expense and fixed interest income as well as other items. After adding the function it is a good idea to compute the repayment line without the function where you simply accumulate all of the items. Equations deriving the cash flow without a circular reference are shown below where t is the tax rate and d is the dividend payout ratio.

CF = EBITDA - Oth - tax - div - int + inc
tax = (EBITDA - int + inc - dep) x t
div = (EBITDA - int + inc - dep - tax) x d
int = fint - CF/2 x Avg Rate
inc = finc + CF/2 x Avg Rate

Substituting for taxes and dividends:

CF = EBITDA - Oth - (EBITDA - int + inc - dep) x t - (EBITDA - int + inc - dep - tax) x d - int + inc
CF = EBITDA - Oth - (EBITDA - int + inc - dep) x t –
(EBITDA - int + inc - dep - (EBITDA - int + inc - dep) x t) x d - int + inc

CF = (EBITDA - int + inc) * (1-t -d * (1-t)) - Oth + dep x t + dep * (1-t) * d
CF = (EBITDA - int + inc) * (1-t - (1-t)*d) - Oth + dep * (t + (1-t) * d)

Substituting for interest income and interest expense:

CF = (EBITDA - fint + finc + CF/2 x Avg Rate) * (1-t - (1-t)*d) - Oth + dep * (t + (1-t) * d)

CF = (EBITDA - fint + finc) * (1-t - (1-t)*d) - Oth + dep * (t - (1-t) * d)/[1-(Avg Rate/2)* (1-t + (1-t)*d))]

Once you have worked through the algebra, the remaining task is to add iterations that compute the effective dividend payout ratio (that cannot be negative), the effective tax rate (that requires the same kind of NOL equations as shown for the cash flow sweep) and the average interest rate (that requires different calculations depending on whether the cash flow is negative or positive. Equations deriving the cash flow without a circular reference are shown below where t is the tax rate and d is the dividend payout ratio. To make the process less tedious once you have the function developed (you only have to do it once), you can put some of the variables such as fixed interest expenses, the interest income rate and other variables just below the cash flow statement as illustrated in the excerpt below. The excerpt also shows how you can test the function to make sure it is working.

Timeline (Base case)	2012	2013	2014	2015	2016	2017	2018
EBITDA	321,201.00	366,697.62	375,245.22	384,005.55	407,466.65	471,058.41	499,561.94
Less working capital changes	30,144.00	11,753.75	10,644.50	11,211.73	10,556.58	11,063.13	11,592.47
Less income taxed paid	72,651.00	85,043.87	83,934.44	82,476.72	85,355.64	101,868.22	106,014.60
Add Deferred Taxes	10,897.00	7,997.04	8,396.89	9,698.41	11,056.19	11,553.71	12,073.63
Add: Other Income	-	-	-	-	-	-	-
Operating cashflow	229,303.00	277,897.04	289,063.18	300,015.51	322,610.61	369,680.77	394,028.50
Less: Capital expenditures	85,108.00	159,940.78	167,937.82	193,968.18	221,123.72	231,074.29	241,472.63
Cashflow before financing	144,195.00	117,956.26	121,125.36	106,047.33	101,486.89	138,606.48	152,555.87
Less interest expense	23,411.00	24,589.35	24,898.99	25,170.62	25,891.09	26,490.09	26,621.25
Add interest income	13,672.00	14,061.93	14,129.91	14,143.02	14,156.09	14,169.07	14,182.64
Less scheduled debt repayments							
Less dividend paid	86,489.00	110,557.03	109,114.77	107,219.74	110,962.33	132,428.69	137,818.98
Add new equity issuances							
Net cash flow	47,967.00	(3,128.19)	1,241.51	(12,200.00)	(21,210.44)	(6,143.23)	2,298.27
Less: Increased Cash for Operations	-	12,315.52	1,279.53	1,343.50	1,269.61	1,326.74	1,386.45
Net Cash Flow to Surplus Cash and Debt	**49,939.78**	**(15,443.71)**	**(38.01)**	**(13,543.51)**	**(22,480.05)**	**(7,469.97)**	**911.83**
Add: withdrawl of surplus cash when negative	-	-	-	-	-	-	-
Less: withdrawl of debt when positive	49,939.78	-	-	-	-	-	911.83
Cash flow after withdrawl	-	(15,443.71)	(38.01)	(13,543.51)	(22,480.05)	(7,469.97)	-
Add: New surplus cash when positive	-	-	-	-	-	-	-
Less: New Debt when negative	-	15,443.71	38.01	13,543.51	22,480.05	7,469.97	-
Remaining Cash Flow	-	-	-	-	-	-	-
Test of Cash Flow							
Adjusted Working Capital	19,247.00	16,072.23	3,527.14	2,856.82	770.01	836.16	905.29
Fixed Interest Income	13,672.00	14,061.93	14,129.91	14,143.02	14,156.09	14,169.07	14,182.64
Fixed Interest Expense	16,365.57	24,280.48	24,898.23	24,899.75	25,441.49	26,340.69	26,639.49
Interest Income Rate	0.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
Interest Expense Rate	5.02%	4.00%	4.00%	4.00%	4.00%	4.00%	4.00%
Opening Surplus Cash	-	-	-	-	-	-	-
Opening Debt Balance	326,174.00	607,012.00	622,455.71	622,493.72	636,037.23	658,517.28	665,987.25
Dividend Payout Ratio	63.54%	70.00%	70.00%	70.00%	70.00%	70.00%	70.00%
Net Cash Flow Function	49,939.78	(15,443.71)	(38.01)	(13,543.51)	(22,480.05)	(7,469.97)	911.83
Computed Cash Flow	47,967.00	(15,443.71)	(38.01)	(13,543.51)	(22,480.05)	(7,469.97)	911.83
Test	1,972.78	-	(0.00)	-	(0.00)	(0.00)	(0.00)

Chapter 13: Advanced Issues that Eliminate Dreadful Circular References Arising from Debt Sculpting, Debt Funding and Reserve Accounts in Project Finance Models

Selected elements of a project finance model are some of the most difficult problems in financial models and cause continuing headaches for modellers. The worst nightmares often result from circular references that cannot be avoided and make a model far less flexible for risk and structuring analysis (violating the F in FAST). Project finance models are often very elegant, detailed and sophisticated in terms of representing a project and they include many complex VBA programs to resolve circular references (for example a pressing a picture of a beautiful sculpture for operating a macro that sculpts debt). But if one cannot easily use these sophisticated models to quickly evaluate different debt structures such as debt sizing from the DSCR or varying the debt tenor and draw down provisions, then the model in fact is all but useless. Similarly, if a model contains hundreds of lines of detail about operating expenses, but it cannot be used to easily measure how a few of the key variables affect returns and ability to repay debt, then it is not really a good model.

Circular references which limit the flexibility and transparency of a model seem unavoidable in a project finance model because of debt sculpting, interest capitalization and funding priorities which makes both the structuring analysis and the risk analysis far more cumbersome. This section deals with how to address items that create inherent circularity. The general philosophy in addressing these difficult issues follows a two pronged approach:

1. See how far one can go in a model using algebraic methods and careful structuring before running into circular reference problems.

2. Address circular reference problems in a transparent and structured manner using a user defined function when they do occur so that structuring and risk analysis can still be performed.

Excel has an option to resolve circular references through making iterative calculations which may seem to make the whole circular reference issue not very important. This involves pressing the iteration button

in the excel options. However in a large project finance model, leaving a circular reference in a file using the excel iteration option is very dangerous because the models are large and become very unstable and almost impossible to work with in terms of risk analysis and financial structuring. On the other hand, resolving the circular references with macros can make the models less transparent and flexible as each time an input is changed it is necessary to run a macro and one cannot directly see how calculations are made. To understand how the circular reference and other related headaches related to sculpting debt, funding construction and reserve accounts can be minimized, his section describes various alternative techniques that leave models much more flexible and transparent. Issues addressed include:

- Debt Repayments using Sculpting
- Capitalized Interest, Fees and Unavoidable Circularity
- Debt Service Reserve Accounts
- Maintenance Reserve Accounts
- Cash Sweeps and Dividend Restriction Covenants
- Re-financing

Before discussing details of alternative methods in dealing with circularity and other issues that arise from sculpting, reserve accounts and funding cascades, a summary of items that cannot be resolved without circular references is presented. Issues that genuinely cause circular references should be studied to avoid jumping to create VBA programs as soon as a circular reference occurs when it is unnecessary.

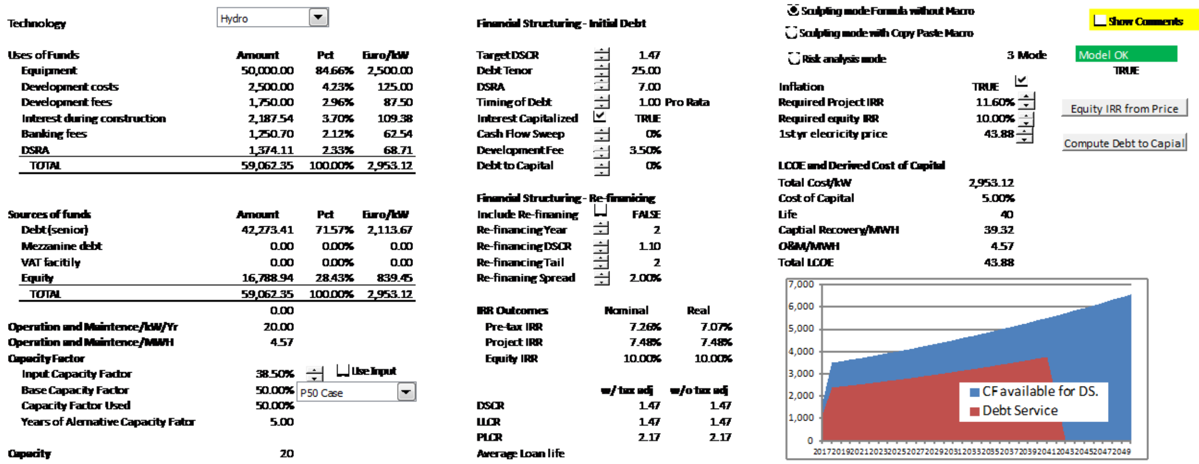
Three of the principal items that cause circular references in a project finance model include:

- **Debt Funding and Capitalized Interest:** The amount of debt that is available to fund construction may be given size of total debt or a given percentage of the total cost. The problem is the total project cost includes capitalised fees and interest. Because funding affects interest and interest affects total cost a difficult circularity problem arises. (The debt funding is the amount of debt that is actually used to pay for cash expenditures rather than being capitalised for interest and fees.) To compute the interest capitalised and the fees, the amount of debt borrowed that is the basis of these calculations is a required input. But this amount of debt funding is not known until the interest and fees are computed because the total debt commitment including interest and fees comes from some kind of sizing algorithm above. Resolving the circular reference can be accomplished by fixing the amount of total funding (not the total debt commitment) with a macro. It is difficult but not impossible to come up with an alternative method using a function with iterative process.

- **Sculpting, Taxes, and Interest during Construction:** When computing debt repayments using the debt sculpting technique the repayments are directly tied to cash flow after tax. Because the debt repayments affect interest expense and cash flow is after tax a circular reference arises. The circular reference is compounded because of the tax effects of depreciation on interest during construction and amortization of fees. Although this circular reference that is very difficult to avoid without a macro it is possible to resolve. One can get close through using a VBA function combined with a backward induction but not get all the way there. The problem can be solved in a comprehensive manner with a user created array function that includes an iteration loop for interest during construction and fees that are affected by the debt size.

- **Interest Income, DSRA and Taxes:** Debt service reserve accounts which impose a cash buffer on a project seem to create an impossible circular reference. In many models there is some kind of elaborate copy and paste macro associated with modelling the account. When using debt sculpting to compute repayments, the repayments affect the DSRA and the interest on the DSRA affects the amount of sculpting. Despite the seemingly intractable problems created by the DSRA, these problems can be solved

through careful structuring and through development of functions, thereby avoiding the need for VBA programs.



Risk Analysis versus Structuring Parts of the Model

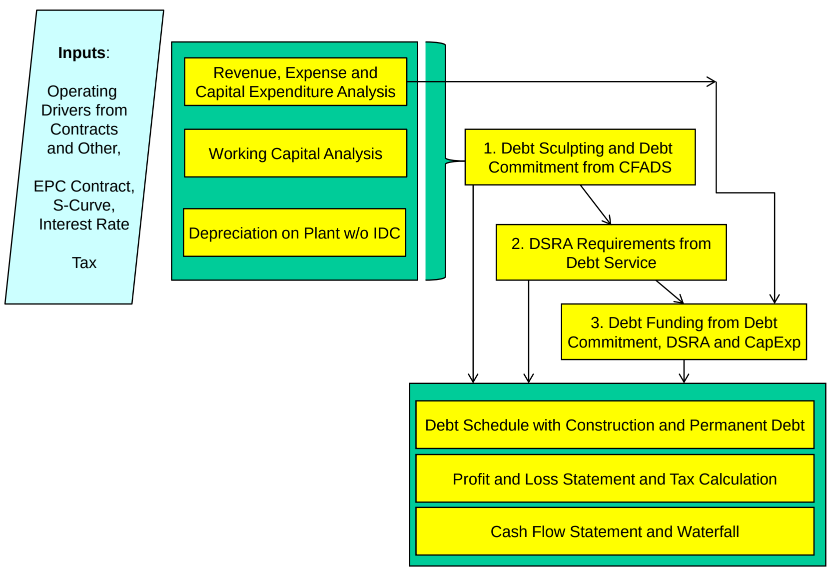
In addressing the issues of debt sculpting, debt funding, debt service reserve accounts (DSRA) and maintenance reserve accounts (MRA), the notion of having different procedures in the model that distinguish between structuring the model on the one hand and performing risk analysis on the other hand is essential. Most of the difficult problems discussed below address structuring functions of a model where debt commitment, debt funding and DSRA accounts are derived from operating cash flow or cash flow available for debt service (CFADS). The first section below demonstrates that complicated structuring aspects of modelling often cannot be solved without a circular reference, but the circular reference can be limited to a few minor items even with complex structuring techniques. The second section demonstrates that if one works hard and is a bit creative, structuring repayments of debt using sculpting can be accomplished without macros that are required in working out the funding portion of the model. The third section demonstrates that even though the debt service reserve account looks forward to determine required balances, circular references associated with the debt service reserve account can be avoided in virtually all circumstances.

Structuring in a model refers to the process of coming up with the debt and equity amounts and repayments using a particular scenario. Issues in structuring include determining the amount of debt from a target debt service coverage ratio; computing the required price in a long-term contract such as a PPA from required return and debt parameters; developing the repayment terms of debt from the debt tenor and the debt service coverage; testing different possible structures for a debt service coverage ratio; and, evaluating different funding possibilities such as pro-rata, debt first or an equity bridge loan. When considering multiple structuring options, it can be difficult to efficiently evaluate different debt structuring options if macros are used to resolve circular references. If a macro button must be pressed every time the debt service coverage ratio is changed, the process can be cumbersome as you have to wait for the macro to clunk along its various iterations before determining how a certain structuring element affects returns. Worse, if the model is used to compute the required contract prices that can achieve IRR targets and DSCR objectives, changing the contract payment requires running a macro, the process can become almost impossible. Given the difficulties in efficiently performing debt structuring where macros are used to resolve circular references, the general approach of the discussion is to go as far as possible without running into a circular reference in order to understand the minimum amount of circular reference calculations that are necessary and to even avoid those.

In contrast to up-front structuring, risk analysis in a model addresses how the transaction works if certain assumptions are varied after the financial structure has been established. In this analysis the amount of

debt, the repayment of debt and deposits and scheduled removals from the debt service reserve account are established and fixed. Unless prospective covenants are modelled, there should be no circular reference including potential circularity associated with the use of prospective debt service in a debt service reserve account. Tricky issues in modelling risk analysis involve the cash flow waterfall discussed above and the alternative methods of risk analysis addressed in the next chapter. Aspects of the waterfall that address structuring mechanics that apply in downside or stress scenarios such as cash flow sweeps, covenants, re-financing, back-up credit facilities and use of debt service reserves should not be part of the initial structuring process.

The order of model sections for more complex structuring issues corresponds to the tree elements above and in a sense works backwards. The first item to compute is the amount of debt commitment from the operating cash flows where the total debt must be repaid at the tenor of the debt. To compute the debt commitment you do not need to know anything about how debt is funded during construction or any other aspects of the funding process (with one small exception for the tax effect of depreciation on construction interest). Once the total debt commitment and the debt repayments are established, the debt service reserve account can be computed. The debt service reserve is also independent of the funding process and only depends on prospective debt service which in turn depends on operating cash flow. The first period debt service requirement is necessary to compute how much debt funding is possible in different periods. Given the total debt commitment and the debt service reserve, the debt can then be spread backwards across the construction expenditures to establish debt draws. Since part of the debt commitment is taken up by interest and fees, not all of the debt commitment can be used to fund construction. The diagram below illustrates a project finance structure with sculpting followed by calculation of the DSRA followed by calculation of debt funding.



Funding of Construction and Circular References Caused by Capitalised Interest, Up-Front Fees and Commitment Fees

The manner in which a project is funded with senior debt, subordinated debt and equity during the construction period can have important effects on the earned rate of return to equity holders. In some projects with parent guarantees, the equity may not be contributed until the construction on the projects are completed (this type of loan is sometimes called an equity bridge facility). In more traditionally financed projects without parent guarantees, the lenders may insist that equity is contributed before debt to demonstrate that the equity holders have “skin in the game” and to assure that they cannot abandon

the project before investing any money. In yet other cases, the equity and debt are contributed on a proportional or pro-rata basis relative to their commitment based on construction milestones. When financing a project, the interest accrued on a loan is sometimes paid to lenders, which increases funding needs. In other cases the interest is not paid to the lender, but instead is capitalized or rolled-up to increase the size of the loan. As with interest costs, the fees paid to lenders can also either be currently paid or be capitalized. If projects are financed with bonds instead of bank loans, the funding occurs in discrete periods and the amount of money contributed to the project from bondholders is more than is necessary for funding the project in a single year. In this case the amount of funding exceeds the sources of funds and interest income earned on cash balances funds some of the construction expenditures.

Depending on which set of funding techniques described above are applied, the funding schedule can be relatively simple or it can be one of the most difficult problems in the programming of a model. Various different possible combinations of funding structures are illustrated in the table below which include capitalizing or paying interest; bond financing with fully drawn funding in a single period; funding on a pro-rata basis where equity and debt are funded in a proportion of their commitment or funding debt or equity before debt; and, capitalization or current payment of fees.

FUNDING STRUCTURE			
Model Mode (1-Structuring; 2 - Risk Analysis)		1	
Structuring Mode	TRUE		
Risk Analysis Mode	FALSE		
Funding Method (1, 2 or 3)		1	
Pro-Rata	TRUE		
Priority: Debt Before Equity, Equity Before Debt	FALSE		
Bond Financing	FALSE		
Pro-Rata Drawdown Percent Approach (1 or 2)		2	
Construction Expenditures Only	FALSE		
Total Fudning Needs	TRUE		
Priority Funding Order (1,2, or 3)			
Senior Debt Last in Priority	FALSE		
Subordinated Debt Last in Priority	TRUE		
Residual Fundng Tranche (1,2, or 3)		1	
Senior Debt	TRUE		
Sub Debt	FALSE		
Equity	FALSE		
Senior Debt Structuring Drivers			
sculpting ratio (DSCR)		1.25	
gearing - debt/equity		85.00%	
annuity switch		FALSE	
Sculpting Method (1 -- forward; 2 -- backward)		1	
Forward NPV Method	TRUE		51,532,994
Backward Method	FALSE		51,532,994

When some of the financing combinations are used (in particular when capitalised interest and fees are not applied and equity is derived after debt is sized) then circular reference can sometimes be avoided through use of algebra or through carefully structuring a model. Another solution is to write a function that solves the funding problem in a variety of different structuring possibilities.

The most obvious problem occurs from capitalised interest and fees. If the total debt commitment is given ahead of time, one does not know the basis for cash draws without capitalised interest that are required in the model until the model itself is created. For example, assume that the cash flow available for debt service (CFADS) combined with at target DSCR results in an implied total debt size of 500,000. The amount actually borrowed – the funding amount -- to pay for construction will be less than 500,000 because some of the total debt funding must be applied to the capitalised interest part of the loan. If the construction period is more than one period, then there is no simple formula to find the amount that can

fund cash construction exclusive of the capitalized interest. Instead, the calculation requires some kind of goal seek function or copy and paste macro that derives the amount of cash funding available from issuing the debt together with capitalised interest will result in the total funding. A similar problem arises in the case of financing fees associated with the debt. If interest is capitalised, then the fees cannot be computed until the total interest capitalized is known because fees are computed on the basis of the total commitment, not the commitment without interest. If the total debt funding is made before or after the equity funding, then the amount of equity funding is not known until the interest during construction is established.

In developing a model that has an inherent circularity problem such as the issue with capitalised interest described in the above paragraph, it is useful to understand the source of circularity and develop methods to solve the circularity that are as simple as possible. To demonstrate the problem, the discussion below begins with cases where no circularity exists. Next, various structural features that cause circularity are added one item at a time to illustrate why the circularity arises and how to resolve the circularity problem. A fundamental idea in working through these issues is that when creating a model with circular references it is good to find and fully understand the ultimate source of the circular reference and solve the problem at the source rather than treating a symptom of the problems after you see a lot of blue arrows in excel. Through finding the ultimate source of circularity, redundant circular references are not treated and potential alternative methods can be applied. On the other hand, if unnecessary circular references are solved through using some kind of macro, goal seek or solver, the process becomes even less transparent and the model is even less flexible.

Case 1: No Circular Reference -- Pro-Rata Funding and Interest Paid During Construction

Circular references arise from the manner in which debt and equity fund construction and the way in which interest and fees during construction are paid or capitalised. The first case is an illustration of a situation where circular references do not exist. Assume the amount of debt funding is determined in advance and debt draws are made depending on the amount of money that is spent on construction (for example, if one fifth of the total expenditures are made in the first period, one fifth of the debt is drawn). The draw-down percentages are determined from a schedule where the construction expenditure for the current period is divided by the total construction across all of the whole construction period implying that the draw down percent does not depend on financing. Importantly, the amount of equity funds is computed on a residual basis from the total amount of funding needs less the debt and the case assumes that there is no interest capitalized, but that interest during the construction period is paid as it is incurred. If a sculpting method is used that does not require a goal seek function, the structuring part of the model can be made without any circular reference. The reason there is no circular reference is that the total debt and equity commitment can be determined from the construction expenditures without making any adjustments for interest expense and fees that are paid on the debt. As debt and equity financing commitment is independent of the interest and fee calculations, the process is not circular. As long as the equity is used as the balancing item in computing the funding requirements (i.e. the senior debt and the sub debt are input), then there is no circular reference.

The step by step approach is shown below:

Step 1: Compute cash funding requirements for each period

Step 2: Compute draw percents independent of debt commitment = (Construction_t/Σ Construction)

Step 3: Debt Funding = Fixed debt commitment x draw percent (i.e. independent of funding)

Step 4: Equity Funding = Funding Requirements – Debt Funding

Calculation of the total uses of funds that is the starting point for all of the methods below is illustrated below. Note that the interest during construction and the fees are included as a funding use whether the interest is paid or capitalised. Adjustments for capitalised interest are shown on the sources of funds implying that with capitalised interest, amounts are shown as both a source and a use of funds:

Assumptions	
Construction Period	3
EPC Cost	100,000
Debt Commitment	80,000
Interest Rate	10%
Debt Funded	80,000
Equity Commitment	20,000
Interest Paid	TRUE

Period	-2	-1	0
Uses of Funds			
Construction	33,333.33	33,333.33	33,333.33
Add: Interest Paid	-	2,666.67	5,333.33
Total	33,333.33	36,000.00	38,666.67
Sources of Funds			
Debt	26,666.67	26,666.67	26,666.67
Equity	6,666.67	9,333.33	12,000.00
Total	33,333.33	36,000.00	38,666.67
Debt Schedule			
Opening Balance	-	26,666.67	53,333.33
Add: Debt Draws	26,666.67	26,666.67	26,666.67
Add: Interest Capitalised	-	-	-
Closing Balance	26,666.67	53,333.33	80,000.00
Interest Rate	10%	10%	10%
Interest Recorded	-	2,666.67	5,333.33
Interest Paid	-	2,666.67	5,333.33
Interest Capitalised	-	-	-

Case 2: Circular Reference from Pro-Rata Funding with Capitalised Interest

If the total debt commitment is given in advance and interest is capitalised instead of being paid currently, then headaches begin. When interest is capitalised, the total amount of debt that can be used to pay for or fund the cash expenditures of project is not known until the interest cost is computed. But the interest is a function of amount of debt issued to fund the project rather than the total debt commitment derived from the sculpting process. This causes a circular reference that is illustrated below where the periodic debt draws to fund cash construction drive the capitalised interest, but capitalised interest drives the accumulated cash debt funding that determines how much of the total debt commitment can fund construction.

Periodic Cash Debt Funding ➔ Capitalised Interest
Capitalised Interest ➔ Total Cash Funding of Debt
Total Cash Funding of Debt ➔ Periodic Cash Debt Funding

In general there are three approaches that can be used to resolve the circular reference associated with capitalised interest. The first option is to use the iteration option in excel which sounds very simple but can lead to big problems when you are trying to use the model. The second option is to create a macro that copies and pastes formulas into fixed cells with a simple iteration loop or to create a macro around the goal seek function. These macros can limit both the flexibility and transparency of a model. The third option is to develop an algebraic solution which takes a lot of work and may require you to make a function in excel. The first two options are tantamount to giving up while the third option can be a big challenge requiring a lot of creativity and perseverance. If you can solve the third option then the model can regain its flexibility and users can see where each calculation comes from. While the common copy and paste function is addressed below, much of the discussion in this section focuses on the third option.

One of the key points to resolving the problem of circularity caused by capitalised interest is to thoroughly understand the difference between debt funding and debt commitment. Debt funding is the amount of debt actually borrowed to pay for cash construction and other requirements. The debt commitment on the other hand includes capitalised interest and represents the amount of debt that must ultimately be repaid. Total funding requirements (in contrast to debt funding) includes construction expenditures, development costs and fees, administrative expenses during construction, funding of the debt service reserve account and payment of interest and fees if they are not capitalised. Part of the total funding can come from debt and part can come from equity. The problem is that the amount of funding that comes from debt and equity depends on the debt commitment and that the mix of debt and equity funding depends on the

capitalised interest and fees. One can illustrate the mechanics of the problem by defining the funding ratio as the amount of the debt funding divided by the debt commitment. Understanding and calculation of the funding ratio is central to solving the principal circular reference problem in a clear a manner as possible. The following set of equations demonstrates the problem:

Cash Funding Requirements = Capital Expenditures + DSRA Funding + Other Items

Given Debt Commitment (from sculpting) = Debt Funded + Capitalised Interest (and Fees)

Funding Ratio = Debt Funded/Given Debt Commitment

Debt Funded = Funding Ratio x Given Debt Commitment

Equity Funded = Cash Funding Requirements – Debt Funded

If the Funding Ratio is known in the above set of equations, then debt funded is a direct function of the debt commitment then the there is no circular reference in the process. If the total funding ratio is computed correctly (either with a copy and paste macro, a goal seek formula or an algebraic formula) then the key test that the process is working is that the given debt commitment that is input (or the result of debt sizing calculations described below). This test – that the computed debt commitment equals the given debt commitment – should be a prominent part of the model verification. The issue with the whole process is that the debt funding ratio must be computed using debt funding. But the debt funding depends on the funding ratio. To resolve this issue one can create a macro or try to compute the funding ratio using algebra. There are many other ways to solve this problem that you will see in financial models. Defining the funding ratio is intended to make the process transparent where you can see the source of the problem.

Computing the funding ratio independent of the debt funding itself can be solved by writing a macro. You can either using the GOAL SEEK function in a macro or by using a copy and paste macro.

```
Iteration = 0

While ABS(Range("Difference_Funding_Needs")) > Range("Precision")

        Iteration = Iteration + 1

        Application.StatusBar = "Running Funding Needs Resolution: Iteration " & Iteration

        Range("Funding_Needs_Fixed") = Range("Funding_Needs_Computed")

        If Iterations > Range("Max_Iterations") Then
                Msgbox "Maximum iterations reached"
                Goto End1:
        End If
Wend

End1:
Application.StatusBar = FALSE          ' re-sets the application bar
```

Instead of using a copy and paste macro, an algebraic equation can be used to derive the funding ratio. To introduce this idea, consider a simple case where the construction occurs in two periods and the capitalized interest is computed on the debt funding. The idea is to put debt commitment and debt funding in the same equation and then divide the debt funding by the total debt commitment. In the set of equations below, the variable Pct_1 is the percent of the construction that occurs in the first construction period.

Debt Commitment = Debt Funding + Capitalised Interest

Capitalised Interest = Debt Funding x Pct_1 x Interest Rate

Debt Commitment = Debt Funding + Debt Funding x Pct_1 x Interest Rate

Debt Commitment = Debt Funding x (1+ Interest Rate x Pct_1)

Debt Funding = Debt Commitment/(1+Interest Rate x Pct_1)

Funding Ratio = Debt Funding/Debt Commitment = 1/(1+Interest Rate x Pct_1)

When additional periods are added to the model, the formulas quickly become more complex as illustrated below in the case of a three period case. In cases with many periods the formulas quickly become unreasonable to apply in a model.

Total Debt Commitment = Debt Funding + Capitalised Interest

Capitalised Interest = Total Debt Funding x Pct_1 x Interest Rate + Total Debt Funding x Pct_2 x Interest Rate

Total Debt Commitment = Debt Funding + Debt Funding x Pct_1 x Interest Rate
+ (Debt Funding x (Pct_1 + Pct_2) + Debt Funding x Pct_1 x Interest Rate) x Interest Rate

Total Debt Commitment = Debt Funding x (1 + Interest Rate x 2 x Pct_1 + Pct_2 x Interest Rate + Pct_1 x Interest $Rate^2$

One could try and write formulas as above as part of the excel model. This would make the models very cumbersome and difficult to follow. Further, each time you would make a model, you would have to remember all of the painful little details that make a modeler's life so horrible. An alternative is to write a function (analogous to the function discussed above for computing accelerated tax depreciation) to remove the long and tedious formulas. This function requires looping through the construction period and computing both the interest that arises from the funding requirements and the interest that is compounded and comes from earlier interest itself. Once the function is computed it looks like any other function in excel that may take a long time to compute by hand (such as the IRR function). The function can later be used in other models and one does not have to go through the burdensome process of re-computing the funding ratio in each model. In developing the functions, it can be a good idea to begin with a relatively simple example and then move to more complex cases unless you are really smart. If there are no fees and if the debt funding is on a pro-rata basis, then the function could have the following form where the funding_period_percent represents the ratio of the funding in a period to the total funding. The trick to accumulating the interest on itself for each period is to compute two loops in the function. The first loop works through the construction period and the second loop accumulates interest associated with each vintage of construction.

```
Function funding_ratio(funding_period_percent, int_rate)

construction_periods = funding_period_percent.Count
ReDim interest(num)
total_interest = 0

For i = 1 To construction_periods - 1
   accum_percent = 0
   prior_interest = 0

   For j = 1 To i Step 1
      accum_percent = accum_percent + pct(j)
      prior_interest = prior_interest + interest(j)
   Next j

   interest(i) = (accum_percent + prior_interest) * int_rate(i)
   total_interest = total_interest + interest(i)

Next i

funding_ratio = 1 / (1 + total_interest)

End Function
```

Case 3: Pro-Rata Funding, Capitalised Up-front Fees

If the total debt commitment is given in advance as in the example above and the fees are capitalised instead of being paid when they are charged, a similar problem arises as with capitalised interest. Part of the debt commitment is taken up with fees making less funding available to finance cash construction. This section addresses the problem with respect to up-front fees while the next section discusses resolution of the issue for commitment fees. As the total commitment is assumed to be given by debt sizing analysis, the total amount of debt that can be used to fund the cash expenditures of project – the debt commitment minus the fees or the debt funding -- is not known until the fees are computed. If the fees are paid currently and not capitalised, then there is no problem as long as the interest is also not capitalised.

To begin the process, assume a simple one period model which is then extended as the case above.

Total Debt Commitment = Debt Funding + Capitalised Fees

Capitalised Fees = Total Debt Commitment x Fee Percent

Total Debt Commitment = Debt Funding + Total Debt Commitment x Fee Percent

Total Debt Commitment - Total Debt Commitment x Fee Percent = Debt Funding

Total Debt Commitment x (1- Fee Percent) = Debt Funding

Funding Ratio = Debt Funding/Total Debt Commitment = (1- Fee Percent)

Case 4: Pro-Rata Funding, Capitalised Commitment Fees

In addition to up-front fees, commitment fees are charged for debt that is committed but not used (from the perspective of the bank, the commitment represents a risky asset and must be compensated for with some kind of credit spread.) As with the up-front fee, a problem arises because the fees change the debt commitment relative to the amount of money that must be borrowed. In this case the total amount of debt that can be used to fund the cash expenditures of project – the debt funding -- is not known until the fees are computed. But the fees are a function of the total amount of the debt commitment which is not known until the debt funding is computed which depends on the fees themselves. If the fees are paid currently and not capitalised, then there is no problem as long as the interest is also not capitalised. As with the prior example for capitalised interest, a circular diagram can be drawn for capitalised fees.

Total Debt Commitment → Capitalised Fees
Capitalised Fees → Debt Funding
Debt Funding → Total Debt Commitment

To begin the process, assume a simple one period model which is then extended as the case above.

Case 5: Equity Funded before Debt

If the owner or sponsor of a project does not provide any guarantee of debt service during construction, then lenders often require the equity contribution to be funded before the debt commitment is borrowed. This manner of funding a project causes circular reference problems because the equity commitment is a function of debt funding (rather than the total debt commitment). However the debt funding requirement is driven by the amount of interest as the given debt commitment less the interest is the definition of funding. Further, the interest and fees are driven by the equity funding because the more the equity funding, the less time the debt is outstanding during the construction period and the less the interest expense. A circular reference problem also occurs when the interest is paid rather than capitalized during construction because if interest is paid, then interest is included in funding requirements. The interest included in funding requirement drives the amount of debt funding and thus the equity funding. The diagram below illustrates how the circular problem arises when there is an equity priority for the funding order and interest is capitalised (funding needs include construction expenditures and debt service reserve funding).

Equity Funding	→	Funding Needs minus Debt Funding
Debt Funding	→	Interest Charged, Fees Charged
Interest and Fees	→	Equity Funding

In this case the circular reference problem can be solved using a backwards approach where the closing balance equals the next year opening balance. This can be thought of as a system where the last closing balance is established and then the opening balance is reduced and reduced each year until it reaches zero. When the opening balance is pushed back to zero in earlier periods of the construction period, then the equity funding must start and continue for the remaining prior periods of the construction period. The opening balance is the closing balance of the debt less the draws and the interest, implying the opening balance declines. Eventually the opening balance would be zero and the debt draws must be constrained using a MIN function.

Before addressing the circular reference, the general mechanics of computing the debt and equity draws is presented. The schedule and equations below demonstrate how one can set-up a model to compute the equity and debt funding assuming that the equity funding is known in advance. The key to implementing these equations is using the MIN function to compute the amount equity funding before debt funding is applied. The approach is the same as the waterfall discussion above where priorities of cash flow are established. This time the process begins with cash funding needs and works through the order of the funding.

Funding Needs (Construction plus debt service reserve funding)
Less: Equity funding from MIN of Funding Needs and Remaining Equity Available
Subtotal 1: Cash Flow after Equity Funding
Equals: Debt Funding Required

To resolve this calculation, the remaining equity balance must be computed from an equity table which increases with new equity issued in each period. Assuming the debt funding is given (which causes the circular reference), the remaining equity balance can be computed using the following equations:

Total Funding Needs = Sum of Construction

Equity Funding = Total Funding Needs – Debt Funding

Remaining Equity Commitment$_t$ = Total Equity Commitment – Opening Equity Balance$_t$

Equity Balance$_t$ = Opening Balance$_t$ + Equity Funded$_t$

Equity Funded$_t$ = MIN(Remaining Funding$_t$, Current Funding Needs$_t$)

Unlike the case above where pro-rata funding was assumed, it is difficult to solve the circular reference when a priority exits with a function and an algebraic equation. Instead, when setting-up funding where equity is contributed before debt, one can set-up a backwards moving debt balance table that begins with the closing balance at the end of the construction period. At this point -- at the end of the construction period -- the closing balance should be the given amount of the total debt commitment, including all capitalised interest and fees. When starting with the closing balance, the opening balance is derived from the closing balance in a process the works backwards. This contrasts with the normal case where the closing balance is computed from the opening balance plus the draws and the capitalised interest and fees. Once the opening balance is derived, the amount of debt draws through funding is limited until the opening balance falls to zero. Here the debt funding is independent of the equity balance and a circular reference can be avoided.

In this case, the interest during construction is not driven by the amount of debt input, but it is driven by the total funding needs in the model. This structure is not realistic with respect to sizing the senior debt, but it may be the technique used if there is subordinated debt in the structure. As illustrated in the

diagram below, when debt is derived instead of equity, the interest cost drives the total amount of funding needs, but the total funding needs drives the amount of debt which in turn drives the interest cost. This change in assumptions creates a circular reference problem because the interest cannot be computed until the debt and the funding requirements are known.

One solution to the above problem is to fix the funding needs as an input and another solution is to fix the amount of the interest cost which is the ultimate source of the problem. If the interest is independent of the funding need, then the debt commitment is also independent of funding and interest no longer depends on the amount of interest itself. Without the fixing the funding requirements, the equations that cause the circular reference problem are:

Total Funding Needs = Construction + Interest Paid
Debt Commitment = Total Funding Needs – Equity Input

Assumptions			
Construction Period	3		
EPC Cost	100,000		
Debt Commitment	80,000		
Interest Rate	10%		
Debt Funded	74,931		
Equity Commitment	25,069		
Interest Paid	FALSE		
Funding Ratio	0.93663912		
Equity Balance			
Total Commitment	25,068.87	25,068.87	25,068.87
Equity Commited	-	25,068.87	25,068.87
Remaining	25,068.87	-	-
Opening Balance	-	25,068.87	25,068.87
Add: Equity Commited	25,068.87	-	-
Closing Balance	25,068.87	25,068.87	25,068.87
Debt Funded	8,264.46	33,333.33	33,333.33

Period	-2	-1	0
Uses of Funds			
Construction	33,333.33	33,333.33	33,333.33
Add: Interest Paid	-	-	-
Total	33,333.33	33,333.33	33,333.33
Sources of Funds			
Debt	8,264.46	33,333.33	33,333.33
Equity	25,068.87	-	-
Total	33,333.33	33,333.33	33,333.33
Debt Schedule			
Opening Balance	-	8,264.46	42,424.24
Add: Debt Draws	8,264.46	33,333.33	33,333.33
Add: Interest Capitalised	-	826.45	4,242.42
Closing Balance	8,264.46	42,424.24	80,000.00
Interest Rate	10%	10%	10%
Interest Recorded	-	826.45	4,242.42
Interest Paid	-	-	-
Interest Capitalised	-	826.45	4,242.42

The circular reference can be solved through fixing the total funding needs and then comparing the computed funding needs with the fixed funding needs. The computed funding needs can be compared with the fixed funding needs to evaluate the accuracy of the fixed funding needs. If difference between the fixed funding needs and the computed funding needs is not zero, then new values of the fixed funding needs can be tried. The whole process can be performed with the debt commitment rather than the funding needs. Advantages of using the debt commitment occur when sculpting difficulties arise discussed in the next section. Disadvantages of using debt commitment rather than the total funding needs are that the process must be developed for multiple debt tranches if several debt tranches are input.

An illustration of how the process may appear in a spreadsheet is shown below. It is best to reduce the circular reference problems to the minimum as possible because if there are multiple problems then the copy and paste macro may take a lot longer to resolve or it may not fully resolve. Given that one of the main problems with a circular reference in a model is lack of transparency in the resolution techniques, if you can present the circular reference problem and solution in as clear a manner as possible, these problems can be reduced. The table below lists the source of the circular reference and allows fixed values or computed values to be used in the applied funding needs column. The funding needs total in turn drives the amount of the financing commitment and is used as the denominator of the funding percentage calculation.

Case 6: Debt Drawn First, No Capitalised Interest, Equity Residual Tranche

The next set of cases, the total debt or equity commitment is drawn with a priority before another commitment. As discussed above, the priority can have different orders with debt being contributed before equity or equity being contributed before debt. To model alternative priorities, priority can be defined with code numbers (e.g. 1,2,3) and the MATCH and INDEX functions can be used to place a the financial commitments in different orders. The process to place different financing inputs in alternative priorities is illustrated below:

Step 1: Compute Cash Funding Needs (Same as above for the pro-rata methods)

Step 2: Enter number one for the financing that is drawn first

Step 3: Use the MATCH function with the number above and the code number for each security

Step 4: Use the INDEX function to label the financing (e.g. debt or equity) and to acquire the commitment, the date of the commitment, the interest rate, the fee percentages and capitalization switches

Step 5: Develop a table that subtracts cash amounts already drawn from the cash commitment (without capitalised interest) to establish the basis upon which draws are established

Step 6: Compute the balance of the cash funding and use the MIN function comparing the amount available to be drawn relative to the funding requirements

Draws = MIN(available commitment left after prior draws, funding requirements)

Step 7: Compute the funding requirements to the next tranche, through subtracting the draws from the prior funding requirements sub-total

Step 8: Enter the number two and repeat the process.

In this case, there is no circular reference problem as long as the equity is the last trance of debt and the equity is the residual financing tranche. In this case, the debt commitment is computed separately from the interest expense.

Method 2: Priority Funding						
Code	1	Security		**Senior Debt**		
Match	1	Cash Funding Commitment		37,103,756		
		Date of Commitment		31-Aug-11		
Total Cash Funding Needs	60,489,627	4,897,113	13,808,929	22,794,692	14,011,816	4,977,077
Commitment Available		TRUE	TRUE	TRUE	TRUE	TRUE
Commitment	37,103,756	37,103,756	37,103,756	37,103,756	37,103,756	37,103,756
Less: Amount Already Drawn		-	4,897,113	18,706,042	37,103,756	37,103,756
Amount Available		37,103,756	32,206,643	18,397,714	-	-
Amount Drawn Senior Debt		4,897,113	13,808,929	18,397,714	-	-
Code	2	Security		Sub Debt		
Match	2	Cash Funding Commitment		7,000,000		
		Date of Commitment		31-Aug-11		
Remaining Funding Needs		-	-	4,396,979	14,011,816	4,977,077
Commitment Available		TRUE	TRUE	TRUE	TRUE	TRUE
Commitment	7,000,000	7,000,000	7,000,000	7,000,000	7,000,000	7,000,000
Less: Amount Already Drawn		-	-	-	4,396,979	7,000,000
Amount Available		7,000,000	7,000,000	7,000,000	2,603,021	-
Amount Drawn Sub Debt		-	-	4,396,979	2,603,021	-
Code	3	Security		Equity		
Match of Code	3	Cash Funding Commitment		16,385,872		
		Date of Commitment		31-Aug-11		
Remaining Funding Needs		-	-	-	11,408,795	4,977,077
Commitment Available		TRUE	TRUE	TRUE	TRUE	TRUE
Commitment	16,385,872	16,385,872	16,385,872	16,385,872	16,385,872	16,385,872
Less: Amount Already Drawn		-	-	-	-	11,408,795
Amount Available		16,385,872	16,385,872	16,385,872	16,385,872	4,977,077
Amount Drawn Equity		-	-	-	11,408,795	4,977,077
Remaining Cash Funding Needs		-	-	-	-	0.00

Case 7: Bond Financing, No Capitalised Interest, Equity Residual Tranche

The seventh case involves bond financing where the total amount of financing is assumed to be drawn in one period. In this case, a bond fund account should be established when the bond is issued. Draws from the senior debt are taken from the bond account using a MIN function in an analogous manner to the priority method above. The process begins with the period by period funding needs as in the cases above except that the interest income is used to reduce the amount of funding needs. After the funding needs are listed, the cash account for the bond is listed. The input into the cash account is the bond financing and the use of cash is the smaller of the use of the balance at the start of the period or the funding requirements. After the bond account is used up, the process is the same as in the other situation; the simplest of which is simply funding with equity. Setting-up the funding process with bond issues is demonstrated in the step by step instructions below:

Step 1: Begin with total funding requirements that includes a deduction for interest income

Step 2: Create a switch variable for the time period during when the bond is issued

Step 3: Develop a bond cash account that adds the bond financing using the switch and subtracts the funding

Step 4: The funding from the bond cash account is computed using the MIN function illustrated below:

MIN(total funding requirements, opening balance)

Step 5: Compute the interest income on the bond cash account

Step 6: Compute the remaining funding requirements and use one of the above techniques to compute the funding from other sources

In the bond financing case there is no circular reference unless techniques such as the drawdown percentages that are derived from interest expense are used to separate the remaining subordinated debt (or bank debt) funding and the equity funding.

Method 3: Bond Financing										
Total Financing Requirements Less Interest Income		5,371,289	13,830,363	22,824,195	14,031,513	5,042,161	-	-	-	-
Bond Financing Date	31-Aug-11									
Bond Financing Amount	52,909,617									
Bond Financing Switch		TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
Bond Cash Account										
Opening Balance		-	52,909,617	39,079,254	16,255,059	2,223,546	-	-	-	-
Add: Draws from Financing		52,909,617	-	-	-	-	-	-	-	-
Less: Amounts Used for Funding		-	13,830,363	22,824,195	14,031,513	2,223,546	-	-	-	-
Closing Balance		52,909,617	39,079,254	16,255,059	2,223,546	-	-	-	-	-
Annual Interest Income Rate		2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Periodic Interest Income Rate		0.17%	0.17%	0.17%	0.17%	0.17%	0.17%	0.17%	0.17%	0.17%
Interest Income Amount		-	87,385	64,543	26,847	3,672	-	-	-	-
Remaining Funding Needs		5,371,289	-	-	-	2,818,615	-	-	-	-
Sub Debt Percent		93.33%	93.33%	93.33%	93.33%	93.33%	93.33%	93.33%	93.33%	93.33%
Equity Percent		6.67%	6.67%	6.67%	6.67%	6.67%	6.67%	6.67%	6.67%	6.67%
Sub Debt Financing	7,000,000	5,013,203	-	-	-	2,630,707	-	-	-	-
Equity Financing	500,000	358,086	-	-	-	187,908	-	-	-	-
Total	7,500,000									

Case 8: Include Capitalised Interest, Set Total Debt Commitment

If the commitment to fund cash expenditures is defined as an input and the total commitment including capitalised interest is derived from the model, there is no a circular reference problem. In this case the funding component of the model can be solved without a circular reference problem because the

capitalised interest is independent of the funding needs. Unfortunately this is not a realistic case because the total funding needs including the capitalised interest are generally structured as a function of the DSCR or the overall leverage ratio.

The eighth case includes capitalised interest and assumes that the total debt commitment including capitalised interest is defined by some sort of criteria such as the debt service coverage ratio or a leverage ratio. In this case, the capitalised interest causes a circular reference problem because the capitalised interest drives the amount of cash funding, but the cash funding also affects the capitalised interest as shown in the diagram below. The circular reference problem can be solved by entering a fixed value for the total capitalised interest in deriving the cash funding commitment. This circular reference only occurs when interest is capitalised and the fixed amount of capitalised interest should only be used when the capitalised interest switch is TRUE.

Cash Debt Funding = Total Debt Commitment – Capitalised Interest

Capitalised Interest ➔ Cash Debt Funding
Cash Debt Funding ➔ Total Debt Balance
Total Debt Balance ➔ Capitalised Interest

If the circularity related to capitalised interest is resolved, some of the cases that created circularity problems above may not require fixing the funding needs. In cases where the circular reference is created from accrued interest, only the fixed capitalised interest is necessary. The table below summarizes cases that create circular references in the funding part of a model. If the debt commitment is used rather than funding needs, the same item can be used for either the interest paid or the interest capitalised.

	Interest Paid	Int Capitalised
Pro-rata Funding with Construction Expenditures	None	Fix Cap Int
Pro-rata Funding with Total Funding Needs	Funding	Fix Cap Int
Priority with Debt First	None	Fix Cap Int
Priority with Equity First	Funding	Funding and Cap Int
Bond Financing	None	Fix Cap Int
Derive Equity	None	Fix Cap Int
Derive Debt	Funding	Fix Cap Int

The table above demonstrates that there are many situations that create a circular reference when working through funding needs. The bad news is that these must be resolved with careful design. The good news is that other complexities in the model involving debt sculpting and the DSRA can be computed with no circular reference.

Debt Sizing and Debt Sculpting

Sizing the debt and determining the debt repayments are among the most important elements of debt structuring in a model. When structuring debt, one often pre-determines the level of the debt service coverage, the leverage or some other parameter and then backs into the amount of the debt commitment that will make the computed debt service coverage ratio equal the target amount. For example, assume the target minimum debt service coverage to obtain a BBB rating is 1.4 in the base case. Alternatively, the debt can be sized by evaluating cash flows in the downside case, in which case the target debt service coverage would be lower. Both the periodic debt repayments and the debt size should be consistent with DSCR. If the debt size results in an unreasonable level of debt leverage such as 95%, then the debt size should be constrained.

If the debt repayment is computed on the basis of annuity payments or equal instalments, then a goal seek process can be used to establish the debt size where multiple trials for the debt commitment are input. If either a level or annuity payment is used, then the DSCR is not constant over the life of the loan unless the cash flow happens to be the same as the debt service over time. Instead of targeting the

minimum DSCR and allowing the remaining coverage ratios to increase, the debt repayments can be varied over time so that the DSCR is the same in each period. The notion of deriving the debt repayments together with the debt size to meet a single target or multiple target DSCR ratios is referred to as sculpting.

Debt sculpting seems to be a difficult process, but there are a variety of different ways to compute debt repayments that make the calculation seem quite simple. Four different techniques are reviewed that demonstrate principle issues in making the calculations. Unfortunately, the simple methods become difficult when taxes and the DSRA income are included in the calculation. The remainder of this section begins by describing the debt sculpting part of structuring a model using artificial case with no taxes and no DSRA account. Four different sculpting methods are described to illustrate how the repayments can be computed. After the simple case, two of the sculpting techniques are discussed in detail in a case with a DSRA account and with taxes. The analysis evaluates how far one can go without running into circular reference problems. After working through the debt sculpting for purposes of debt sizing, techniques to use both sculpting and risk analysis in a model are addressed. At the end of the section, debt sizing in cases with level repayment or with annuity payment is discussed.

Four Sculpting Approaches in Simple Case with no Taxes and DSRA

The complexities of programming a debt structure that results in constant DSCR over the lifetime of debt can be demonstrated in a simple case with no taxes and no DSRA. The first case uses the excel SOLVER to find both the size of the debt and each debt repayment given the pattern of expected cash flow. The second approach uses a little bit of algebra along with the GOAL SEEK function to size the debt and find the debt repayments. The third method uses the fact that the present value of cash flow at the debt interest rate equals the amount of debt initially issued to size the debt along with the algebra from the prior method. The final method sizes the debt by setting the closing balance at the end of the debt tenor to zero and then backs into the amount of debt that must be issued to result in the zero closing balance.

Method 1: Use of Solver in Sculpting

To illustrate the alternative sculpting approaches, imagine a simple case where the operating cash flow to the project varies over time and that the operating cash flow equals the CFADS (there is no interest income and no taxes). The general objective of the sculpting process is to adjust the debt repayments so that the DSCR will be constant over time given the varying operating cash flow. After setting up a debt schedule with an arbitrary amount of initial debt, one can imagine using multiple GOAL SEEK functions to compute the repayment in each period such that the computed DSCR equals the target DSCR. In these cases where multiple GOAL SEEK functions are required, you can instead use the SOLVER tool that allows you to solve for multiple target cells instead of one cell. When running the solver to find the repayments, the process works nicely to find the debt repayment, but the closing balance of the debt does not reach a value of zero unless you happened to enter an amount of initial debt that happens to repay all of the debt. To make sure that the debt is fully repaid, an additional constraint should be entered into the SOLVER that sets the closing balance of the debt to zero. In addition, an additional finding variable should be added that allows the size of the debt issued to change.

The step by step mechanical process for using the SOLVER tool to sculpt is demonstrated below. When entering items in the SOLVER tool, it is not necessary to enter anything into the initial section:

- Add the initial debt issued and an array for the repayment for each period in the CHANGING CELLS section of the solver.

- Add a constraint that the computed debt service ratio equals the target debt service coverage ratio

- Add a constraint that the final debt balance must be zero.

It may be helpful to set-up a macro to re-do the solver with a macro. Unfortunately, this is a bit complex because the visual basic must be adjusted to allow the solver to work. This process involves:

- Step 1: Press the Alt-F11 key to get the visual basic menu
- Step 2: Go to the TOOLS, REFERENCE option and then click on the SOLVER option.
- Step 3: After beginning to record a macro, re-set the solver
- Step 4: Make sure the first part of the solver is not blank
- Step 4: Re-do the solver
- Step 5: Add a Userfinish = FALSE after the SolverSolve

An example of the solver code with the adjusted finish is illustrated below. All of the lines of code except the last line come from simply recording the macro after running the solver.

```
SolverReset
SolverOk SetCell:="$I$5", MaxMinVal:=3, ValueOf:="0", ByChange:="$G$32,$G$46"
SolverAdd CellRef:="$L$2", Relation:=2, FormulaText:="0"
SolverSolve UserFinish = False
```

The solver method is clumsy and performs very slowly in a large model. If you change the tenor of the debt, then you would have to go back to the SOLVER tool and re-enter all of the repayments and the target DSCR arrays. Because of these problems it is doubtful that the method would be used in real models. However, it is useful to discuss the method because it illustrates the various considerations that must be made in setting the repayments and at the same time sizing the debt, particularly the notion that the debt is sized by setting the ending debt to zero.

Method 2: Goal Seek and Algebra

A more elegant solution for sculpting debt is to compute sculpted debt repayments using a formula tied to cash flow and then size the debt with a simple goal seek. The process involves re-arranging the basic formula for DSCR which is the cash flow divided by the debt service along with the formula that debt service is the interest expense plus the debt repayments. Using this method, the repayment can be derived as a function of the DSCR and the operating cash flow as illustrated below (note that this formula can only be applied if the interest expense is computed from the opening balance of the debt, implying that cash flows occur at the end of the period):

DSCR = Cash Flow/(Interest + Repayment)

(Repayment + Interest) x DSCR = Cash Flow

Repayment = Cash Flow/DSCR - Interest

When applying the formula above in a model, although the repayment yields the appropriate DSCR, the size of the debt does not mean that the ending balance of debt at the final repayment date becomes zero. The method is analogous to the first part of the SOLVER method above before adding the additional constraint to set the closing balance of the debt to zero. To deal with the problem of non-zero debt ending debt, a goal seek formula can be used to determine the leverage percent or the total debt commitment in order to set the ending debt balance to zero as illustrated below:

Set Closing Balance to Zero by Changing Initial Debt Issued

It is useful to add a macro to the goal seek so that any time you change an input into the model you can re-size the debt. The only problem with the macro is that the ending debt cell may vary depending on the term of the debt (in many modelling problems, once you open one door to fix a problem, another door appears.) To fix this problem, you can use the SUMPRODUCT function along with a test for the term of the debt as illustrated below:

Goal Seek Debt = SUMPRODUCT(Closing debt balance series x (period = term of debt))

The result of this SUMPRODUCT function can then be used in the goal seek with the macro to establish the debt level that works with the sculpting.

While this method is more flexible than the SOLVER method, the approach still requires a GOAL SEEK function and should include a macro. The goal seek must be run after changing any input for operating cash flow, the interest rate on debt, the tenor of the debt or the target DSCR. If you are structuring the model to find a price that will realize an equity IRR target, this means two goal seek functions must be run which limits the flexibility of a model.

Method 3: NPV of Debt Service from and Independent Calculation

An elegant way to solve the sculpting problem is to use the formula above for computing debt repayments and then to use the fact that the present value of debt service equals the value of the debt. In this case the goal seek can be avoided and the model can be used to compute debt sculpting without running a macro. The trick in this calculation is that the present value of the debt service must be independent of interest expense or repayment calculations in the debt sculpting calculation. If the debt service from the sculpting analysis is used to compute the present value of the debt, then the debt service depends on the initial closing balance of the debt, but the closing balance is the present value of the debt. You end up with a hopeless circular reference. On the other hand if the simple idea that the debt service is the EBITDA/DSCR is used to compute debt service and then the present value of debt service, the calculation of the debt service is independent of sculpting and present value of the independent debt service yields the closing balance of the debt which is now not dependent on the sculpting calculation.

When applying the NPV formula or the GOAL SEEK method above, the repayment must only occur in the debt repayment periods. A switch can be created for the debt repayment period and the required debt service can be calculated as the CFADS divided by the target DSCR multiplied by the debt repayment switch. Using this technique, the whole sculpting process can be boiled down to three formulas as illustrated below:

DSCR = CFADS / Debt Service

or,

Required Debt Service = (CFADS / Target DSCR) x Debt Repayment Switch

and,

Total Debt Issued = NPV(Interest Rate, Required Debt Service)

Repayment = Required Debt Service – Interest Expense

The big advantage of this method is that the debt service coverage ratio can be entered as an input and the amount of the debt is computed with no SOLVER, no GOAL SEELK and no macro. One problem that is manageable is in using the formula is that the NPV formula cannot be used if the interest rate changes over time. In project finance transactions, the credit spread often increases over the term of the debt to encourage re-financing meaning that it is likely the interest rate will change. When computing the present value of the loan with changing interest rates, the normal formula for the discount factor – 1/(1+interest rate) ^ period -- does not work because the compounding effects of earlier changes in interest rates are ignored. To illustrate the problem, assume an extreme case where the interest rate is 50% in the first year and then the rate falls to zero in the second year. Also assume that the CFADS divided by the DSCR is 100 in each year. In this case, the present value of the cash flow using the traditional formula is 166.7 as illustrated below.

PV of Cash Flow = 100/(1.5) + 100/1.0 = 66.67 + 100 = 166.67

If the initial debt balance of 166.7 from this present value formula is applied, then the balance of the debt does not fall to zero, but remains 40 as illustrated below (the sum of the repayment and interest is 100 in each year):

Opening Balance		166.7	140.0
Less: Repayment		16.7	100.0
Closing Balance	166.7	140.0	**40.0**
Interest Rate		50%	0%
Interest		83.3	0.0

The discounting problem occurs because the value of the second 100 cash flow should be reduced by the 50% interest rate in the first period, as you would have to pay 50% interest in the first year if you want to borrow the 100 in the second year – you cannot ignore the discounting effects related to the cost of money in the first year. Therefore, the present value and the total debt balance should be 100/1.5 in each year, or 66.67 times 2 or 133.33. The discount factor can be computed by first calculating an index of the interest rate in the same manner as one would compute the index for the inflation rate. After the index is computed, the discount factor is one divided by the index as illustrated below:

$$\text{Index}_t = \text{Index}_{t-1} \times (1+ \text{Rate}_t)$$

$$\text{Discount Factor} = 1/\text{Index}_t$$

When the compound discount factor is used as above, then the discount factor is 1.5 for both years (in the second year the index is 1.5 x 1 or still 1.5 because of the assumption that the interest rate is zero in the second year). Here the total present value of the debt is 133.3 and closing balance of the debt falls correctly to zero.

Opening Balance		133.3	100.0
Less: Repayment		33.3	100.0
Closing Balance	133.3	100.0	0.0
Interest Rate		50%	0%
Interest		66.7	0.0

Method 4: Backward Induction

The whole process of sculpting starts with cash flow generated from a project and works backwards to find debt service and then the amount of debt that a project can support in order to repay the debt in the final period. A fourth method that works backward can be used to compute the debt repayments and the amount of debt issued at the same time is beginning with the closing balance of debt rather than the opening balance of the debt. If one begins with the closing balance instead of the opening balance, then one can work backwards and make the next period opening balance equal to the opening balance. In this case, items after the closing balance do not cause a circular reference while items that are before cause a problem. Through beginning with zero and working backwards, no net present value formula is necessary, but the debt repayment formula is a bit more difficult. Even if you do not use this method, it is instructive to work through the repayment formula for other aspects of a financial model such as the debt service reserve account.

In setting the closing balance, it is convenient to create a switch for the period of the date of the debt tenor of the loan. For the date of the debt tenor, the closing balance is zero. For all of the other periods, the closing balance is equal to the NEXT period opening balance (in contrast to the normal case in which the opening balance is equal to the PRIOR period closing balance:

Closing debt balance = IF(debt tenor, 0, next period opening balance)

Once the closing balance is set, the opening balance is equal to the closing balance plus the repayments (which contrasts with the normal case in which the closing balance is equal to the opening balance minus the repayments.)

Opening debt balance = Closing debt balance + Debt Repayment

The debt repayments cannot be computed using the formula (CFADS/DSCR – interest) because the required debt service less the interest since the interest depends on the opening balance and the opening balance of the debt is a function of the debt repayment. Instead, a bit more algebra can be used to compute the debt repayment. To see how the formula works, calculation of interest expense using the debt repayment rather than the opening balance of the debt should be understood. The interest expense can be computed as function of either the next period interest expense of the closing balance of the debt instead of the opening balance of the debt by recognizing that the opening balance of the debt less the repayments is the closing balance. Alternative interest expense calculations are shown below:

Interest Expense = Repayment x Interest Rate + Next Period Interest Expense

Interest Expense = Repayment x Interest Rate + Closing Balance x Interest Rate

Given the latter definition of interest expense, the repayment can be derived from the debt service and remain be independent of the interest. Since the debt service is given by CADS divided by the target DSCR, no circular reference problem should be present. The repayment can be computed independently of the interest expense is illustrated below. All elements that include repayment are moved to the left hand side of the equation:

Required Debt Service = Interest Expense + Repayment

Repayment = Required Debt Service – Interest Expense

Repayment = Required Debt Service – Repayment x Interest Rate - Closing Balance x Interest Rate

Repayment + Repayment x Interest Rate = Required Debt Service - Closing Balance x Interest Rate

Repayment = (Required Debt Service - Closing Balance x Interest Rate)/(1+Interest Rate)

Using the backwards method, the repayment function above is entered for repayments, the closing balance at the debt tenor is set to zero and the opening balance is the closing balance plus the debt repayment. The closing and opening balance grow because of the debt repayment and the opening balance at the start of commercial operation is the debt balance. After working through the equations for repayment, interest and opening balance, it is helpful to test whether the computed debt service coverage equals the actual debt service coverage. The usefulness of equations such as this will be demonstrated in the next section where taxes and the debt service reserve account are included in the analysis.

Sculpting Approaches in Complex Cases with Taxes and DSRA

The CFADS is intended to represent cash flow that is available to pay debt service and should reflect the definition of what is available to pay debt service in a loan document for purposes of defining the debt service coverage ratio. Revenues that are collected (after working capital changes) are available for paying debt service, but generally only after operating expense are paid and after provisions for reserves that are input into a maintenance reserve account. Generally, taxes paid are deducted from the revenues and interest income earned on reserve accounts is included in the CFADS. A final item that may or may not be included in the definition of CFADS is the changes in the DSRA account that may provide cash or require cash. Inclusion of taxes, interest income and changes in the DSRA complicate the debt sculpting process and highlight the advantages and disadvantages of the methods discussed above.

If there are no taxes and the interest income rate is so low that it can be ignored, one of the latter two methods above can be used. As soon as taxes are introduced, the backwards method has advantages because the NPV formula method uses interest expense and interest expense drives taxes.

Problem 1: Interest Income

CFADS is used to compute sculpted repayments, but the CFADS depends on interest income from DSRA which also depends on debt. The problem of circularity from income associated with DSRA is illustrated below:

Debt	→	DSRA
DSRA	→	Interest Income, DSRA Changes
Interest Income, DSRA Changes	→	CFADS
CFADS	→	Debt

Assuming that the debt service reserve account represents one debt service payment (this is the general case with semi-annual modelling and with a six month debt service reserve account), the following formulas can be used to resolve the problem without a circular reference using the third NPV method above. One of the main tricks is to recognize that the opening debt service reserve account is equal to the debt service as illustrated below:

Interest Income = Opening DSRA Balance x Interest Income Rate

Closing Debt Service Reserve Balance = Future Debt Service

Opening Debt Service Reserve Balance = Current Debt Service

Using the fact that the opening balance of the debt service reserve account is the current debt service, the following formula can be derived to compute the debt service that does not depend on the interest income. In the formulas below DS stands for debt service:

DS = (Operating Cash Flow + Interest Income)/Target DSCR

DS = Operating Cash Flow/DSCR + DS x Income Rate/DSCR

DS - DS x Income Rate/DSCR = Operating Cash Flow/DSCR

DS = (Operating Cash Flow/DSCR)/(1-Income Rate/DSCR)

Using this formula, the debt service can be made independent of the interest income and the present value of the debt service can be used to compute the balance of the debt.

Problem 2: Sculpting with Income Taxes without Depreciation on Capitalised Interest

When income taxes are introduced, the problem of sculpting becomes more difficult to solve since income taxes are deducted in the calculation of CFADS. The problem arises because the amount of debt drives the interest expense which in turn drives taxes. But the taxes affect the CFADS which drives the debt calculation. Unfortunately, a simple equation cannot be used to conveniently solve the problem because interest expense affects taxes but the debt repayment component of debt service does not affect taxes. The problem with taxes and debt sculpting is illustrated below.

Debt and Sculpting	→	Interest Expense
Interest Expense	→	Taxes
Taxes	→	CFADS
CFADS	→	Debt and Sculpting

If a method other than the backward looking approach is applied, the sculpting process requires fixing the amount of total debt to avoid the circular reference. Because the debt is independent of the cash flow, interest expense is a function of the fixed debt and the circularity is removed. This can be accomplished with a copy and paste macro using the NPV approach or it can be solved with the GOAL SEEK tool. In many cases, this is a reasonable approach as even if complicated formulas are developed below, some circular problems still remain.

Resolution of a circular reference through copying and pasting involves the following steps:

1. Create an area of the model where the circular reference will be resolved. In this section first link the variable that is causing the circular reference and must be fixed. In the case at hand this variable is the NPV of the debt service should be displayed clearly.

2. Next, create a cell or an entire row of cells that has fixed numbers next to or below the link to the cell that is creating the problem. This fixed cell will be used in the calculations for the model. For example, the NPV of the debt service is used as the debt commitment in the debt balance calculation and in the debt issued calculation of the permanent debt.

3. Compute the difference between the linked cell in step 1 versus the fixed cell in step 2. The macro will work by copying and pasting the computed numbers in step 1 to the fixed cell in step 2 over and over again until the difference goes to zero.

4. To create the macro, switch on the macro and then copy the computed cell or cells in step 1 to the fixed cells in step 2. After you have created the macro, you should modify it in order to copy it over and over until the difference goes to zero.

5. To modify the macro to loop around until the difference goes to zero, you can add two lines to the macro. The first line begins the loop called a while loop. The second line ends the while loop. These statements should be above and below the code created by the copy and paste process. The WHILE function can be written something like WHILE RANGE(“Difference”) <> 0 meaning that the process will continue as long as the range is not difference. The WEND statement simply tells what commands should be copied and pasted.

6. As with any macro you should name the ranges so the macro will be flexible when you insert or delete rows or columns.

A copy and paste macro with some extra bells and whistles is demonstrated below. A variable named ITERATION is created that keeps track of how many times the copy and paste macro is looping around. It is good practice to create and IF statement in the macro to limit the number of iterations so that the loop does not continue indefinitely. The macro demonstrated below uses the APPLICATION.STATSBAR function to document how many times the computed cells are copied to the fixed cell. In setting-up the copy and paste macro, if there is only one variable such as the NPV of the debt service that is fixed, then all of the copy and paste coding created when you copy the macro can be replaced with a simple statement such as RANGE(“fixed”) = RANGE(“computed”). As stated above, all of the variables such as the fixed funding and the computed funding should be in the same area of the spreadsheet so the process is as transparent as possible.

```
Iteration = 0

While ABS(Range(“Difference_Commitment”)) > Range(“Precision”)

    Iteration = Iteration + 1

    Application.StatusBar = “Running Commitment Resolution: Iteration “ & Iteration

    Range(“Commitment_Fixed”) = Range(“Commitment_Computed”)
```

```
        If Iterations > Range("Max_Iterations") Then
                Msgbox "Maximum iterations reached"
                Goto End1:
        End If
Wend

End1:

Application.StatusBar = FALSE                ' re-sets the application bar
```

The circular reference can be just about avoided if the backwards method introduced above is modified for incorporation of taxes. Here, an equation can be used to compute repayments that are a function of interest rates as well as tax rates rather than the simple equation above. The process of creating an equation for the debt repayment with taxes is demonstrated below without interest income from the DSRA (which further complicates the equations).

To begin the process, define required debt service as a function of CFADS less taxes.

CFADS = Operating Cash Flow - Taxes

DS = (Operating Cash Flow – Taxes)/Target DSCR

DS = Interest + Repayment

Also create a separate equation for taxes that is substituted into the required debt service calculation, where T is the tax rate and then substitute the new tax equation into the debt service equation above and then simplify the equation:

Taxes = (Operating Cash Flow – Depreciation – Interest) x T

DS = (Operating Cash Flow – Operating Cash Flow x T + Depreciation x T + Interest x T)/DSCR

DS = (Operating Cash Flow x (1-Tax Rate) + (Depreciation + Interest) x T)/DSCR

With the debt service calculation above, you can use the same calculation introduced in the simple no tax case for interest that is a function of debt repayment. Once this interest calculation is substituted into the debt service formula one can re-arrange the equation and collect the debt repayment terms so that the debt repayment terms and made independent of interest expense. As the backwards method is used, the closing balance can be part of the equation without creating a circularity problem.

Interest = Closing Balance x Interest Rate + Repayment x Interest Rate

Putting the equations together and making abbreviations:

- RP – repayment;
- OCF – operating cash flow;
- DP – depreciation expense;
- RATE – Interest Rate;
- CB – closing balance
- DS – debt service

Using the abbreviations, the formula for debt service above is:

DS = Interest + RP

Interest = CB x RATE + RP x RATE

Interest + RP = (OCF x (1-T) + (DP + Interest) x T)/DSCR

Next, substituting the formula for interest expense yields a longer equation:

CB x RATE + RP x RATE + RP = (OCF x (1-T) + (DP + CB x RATE + RP x RATE) x T)/DSCR

Then, moving all items with RP to the left hand side of the equation produces the following equation:

RP x RATE + RP - RP x RATE x T/DSCR = (OCF x (1-T) + (DP + CB x RATE) x T)/DSCR - CB x RATE

RP x (1+RATE – RATE x T/DSCR) = (OCF x (1-T) + (DP + CB x RATE) x T)/DSCR - CB x RATE

RP = [{OCF x (1-T) + (DP + CB x RATE) x T}/DSCR - CB x RATE] / (1+RATE – RATE x T/DSCR)

To apply this equation and keep the formulas reasonable, you can copy this formula to your model. After copying the formula, you can list various lines for the various factors such as the operating cash flow, the tax rate, the depreciation rate and so forth. Then you can separate the formula into various parts. For example, you can split the denominator from the numerator and use an intermediate formula for the CB x RATE. An example of applying the formula through separating factors into different rows is shown below.

RP = [(OCF x (1-T) + (DP + CB x RATE) x T)/DSCR - CB x RATE] / (1+RATE - RATE x T/DSCR)								
Debt Schedule								
Periodic Interest Rate	2.875%	2.875%	2.875%	2.875%	2.875%	2.875%	2.875%	2.875%
Target DSCR	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33
Operating Cash Flow	1,756.65	1,775.99	1,834.95	1,844.40	1,915.59	1,924.91	1,998.65	2,007.83
Tax Rate	35%	35%	35%	35%	35%	35%	35%	35%
Depreciation and Amortisation	1,467.11	1,467.11	1,467.11	1,467.11	1,467.11	1,467.11	1,467.11	1,467.11
CB x Rate	1,259.59	1,250.22	1,239.82	1,229.07	1,217.09	1,204.73	1,191.07	1,176.99
Denominator	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Numerator	316.48	332.84	369.31	381.85	425.47	439.13	485.24	500.10
Computed Repayment	309.91	325.93	361.65	373.93	416.64	430.02	475.17	489.73
CFADS	2,099.29	2,108.74	2,143.78	2,146.29	2,188.80	2,190.66	2,234.27	2,235.46
Required Debt Service	1,578.41	1,585.52	1,611.87	1,613.75	1,645.71	1,647.11	1,679.90	1,680.79
Computed Debt Service	1,578.41	1,585.52	1,611.87	1,613.75	1,645.71	1,647.11	1,679.90	1,680.79
Check of Interest	-	-	-	-	-	-	-	-
Check of DSCR	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33

There is a remaining problem with this method is that depreciation on interest during construction and fees during construction still cause circularity.

Problem 3: Income Taxes with Interest Income

If there is a debt service reserve account with sculpting and no interest income the problem can be resolved without a circular reference. The size of the debt service reserve account is determined after the sculpting calculation is made and the debt service reserve does not affect the sculpting. However, if interest income is included on the debt service reserve account, the sculpting problem becomes complex.

As can be seen from the equation below, the resolution of circular reference problems involve a long formula that can be painful to type into a program. The good news is that you only have to enter it once and then you do not have to run the GOAL SEEK or copy and paste macro. The bad news is that you have to enter the formula. Further, if there are other items that are tax deductible and other items affect debt service and if there is interest income, then the formula becomes even longer. The formula for repayments is demonstrated below.

RP = [(OCF x (1-T)/DSCR + CB x (R x T/DSCR + R x DP x I x (1-T)/DSCR -R) + (OI + OM) x DP x I x (1-T)/DSCR - OI - OP + (OI + SI) x T/DSCR] /
(1+ R - R x T/DSCR - R x DP x I x (1-T)/DSCR - DP x I x (1-T)/DSCR)

In this formula the following abbreviations are used:

OCF – operating cash flow
T – tax rate
R – interest rate on debt
I -- interest income rate on debt service reserve account
CB – closing balance of debt
DP -- depreciation expense
OI -- other interest expense that is tax deductible
OM -- other maturities
SI -- deductible other interest

To use the formula in a model (it still has problems because of capitalised interest associated with depreciation expense that is tax deductible), you can create a function and separate the formula into different parts as shown below.

```
Function repayment(EBITDA, t, DSCR, CB, rate, DP, irate, OI, OM, DEP, SI, OD)

        part1 = (EBITDA * (1 - t)) / DSCR
        part2 = CB * (rate * t / DSCR + rate * DP * irate * (1 - t) / DSCR - rate)
        part3 = (OI + OM) * DP * irate * (1 - t) / DSCR - OI - OP + (OI - SI) * t / DSCR
        part4 = (1 + rate - rate * t / DSCR - rate * DP * irate * (1 - t) / DSCR - DP * irate * (1 - t) / DSCR)

        repayment = (part1 + part2 + part3) / part4

End Function
```

Problem 4: Tax Effect of Depreciation on Interest during Construction

When you define depreciation expense as the total depreciation including depreciation on capitalised interest and amortization of up-front and commitment fees in the above formula, all of the work will still result in a circular reference because the debt sculpting process changes a component of the depreciation expense. On the other hand, if you do not include depreciation on interest during construction and amortization of fees, there will be a small error in the formula as the actual cash flow is somewhat higher due to these additional deductions. The tax effect of interest during construction cannot be resolved by a simple formula and the circular reference problem is illustrated below.

Debt	→	Interest during construction
Interest during construction	→	Depreciation Expense
Depreciation Expense	→	Taxes
Taxes	→	CFADS
CFADS	→	Debt

There are a couple of solutions to this problem that can make the model effective for structuring analysis even with this problem:

1. Compute the tax effects of fees and the tax effects of IDC depreciation separately from other taxes when you work through the profit and loss statement. Then, you can compute the DSCR with and without the tax effect of these two items which are generally very minor relative to other cash flows. The DSCR without tax effects of IDC depreciation and fee amortization is used to compute the debt repayments using the formulas above where the CFADS does not include the tax effects of these items. A spinner box can be used with the where the target DSCR does not include the tax effects of IDC depreciation and fee amortization and then output DSCR with the two items can be shown next to the spinner box. This approach works when interest and fees are not capitalized.

2. Compute the balance of the interest during construction and the fees and then make a copy and paste macro to the amount. After fixing the amount of interest during construction and fees, you can use the fixed amount in computing depreciation expense and fee amortization for tax

purposes. The copy and paste macro can be avoided as you are working with the model because it is such a minor item and it can only be run when the process is finished to fine tune the model.

3. Create a variable that measures the IDC and fee amortization as a percent of the base amount. After creating this variable, copy it to a fixed cell and create a copy and paste macro.

The method also does not work in cases of expected tax loss carryforward. In these cases a copy and paste macro can be used. Finally, if you are very sophisticated, you can make a formula that accounts for movements in the DSRA for purposes of computing CFADS. This problem is very difficult to solve with a copy and paste macro and requires lengthy algebra.

Debt Sizing with Level Re-payments or Annuity Re-payments

If the debt commitment is an input to the model and repayments are computed on the basis of either level payments or annuity payments, then the amount of the commitment can be computed using the goal seek or the solver. The target DSCR is an input and the debt commitment is derived to yield the DSCR given equations for the debt repayment. The debt repayment is simply the total debt commitment divided by the term of the debt or the PPMT function. Creating the macro involves the following steps:

- Enter the target debt service coverage in the model and name the range using the SHIFT, CNTL, F3 keystrokes;

- Turn on the record macro button and then use the goal seek process to set the debt service coverage ratio by changing the debt commitment;

- Modify the recorded macro through using the macro edit button or the ALT, F11 combination of keys;

- When editing the macro, you will see code that defines the goal seek process. To edit the macro, replace the fixed number with the cell reference as illustrated below, where the target debt service coverage ratio is in cell F20;

  Before: Range("F14").GoalSeek Goal:=1.5, ChangingCell:=Range("F4")

  After: Range("F14").GoalSeek Goal:=Range(“F20”), ChangingCell:=Range("F4")

- Replace the cell references with range names in the macro (a practice that should always occur because otherwise the macro will not work when you insert or delete rows);

  Range("C_DSCR").GoalSeek Goal:=Range(“Target”), ChangingCell:=Range("Debt")

- Create a spinner box that is linked to the target debt service coverage ratio (you will have use the cell link to an open cell and then divide the cell by 100).

- Attach the macro to the spinner box, through right clicking on the spinner box.

Debt Service Reserve Accounts

Structure of the DSRA

Project finance transactions and some leveraged buyout transactions include requirements to put cash aside in a bank account to assure that there is a buffer to meet prospective debt service requirements. A typical requirement is that the next semi-annual debt service payment must be held in an account and must be always available as a buffer. Such an account assures that temporary blips in cash flow will not

cause a default and assure that if something bad happens and the debt needs to be restructured, that sufficient time is available for restructuring. For owners of the company, the problem with locking up cash in this manner is that holding cash on the balance sheet and earning a return much lower than the overall equity return can be very expensive in terms of the rate of return on equity. For example, if a project borrows money at a rate of 7% to fund the DSRA and then puts the borrowed money right back into the bank, it may receive interest income at a much lower rate, say 1.5%. This low income rate relative to the interest expense rate can have a big negative effect on the equity IRR, particularly in the case of projects with tight coverage. An alternative to holding cash in a debt service reserve account is to acquire a letter of credit. In this case a commitment fee must be paid, but the project does not experience the cost of borrowing money at a high rate and earning a much lower rate. Further, with the letter of credit, the more debt can be issued for the construction expenditures.

Issues associated with the debt service reserve account can cause major headaches in modelling but they do not have to if the structure of the DSRA is structured in a careful manner. The debt service reserve account is often associated with elaborate copy and paste macros that copy an entire row in a model. This section demonstrates that circularity is not inherent in modelling the debt service reserve account and that a couple of tricks including separating construction funding from permanent financing can eliminate circularity problems. Some headaches are caused by the fact that the DSRA reserve account depends on the next period debt service and if there is a cash sweep, then the interest expense depends on the cash flow after adjustments to the DSRA. Other problems with the DSRA account arise because sculpting of debt is driven by CFADS which in turn depends on the taxes and interest income.

Debt service reserve accounts can present tricky modelling issues from a technical standpoint because the debt service is computed on a prospective basis. Since the debt service reserve cash flows depend on the next period debt service and the next period cash debt service may depend on debt service reserve cash flow, a difficult circularity problem can arise. Other mechanical issues include: (1) computing changes in the debt service reserve account that arise from changes in debt service; (2) calculating uses of the debt service reserve account when there is deficit cash flow; (3) building-up the debt service reserve account from cash flow in a project; (4) withdrawing amounts from the debt service reserve account when debt matures; (5) adding amounts to the debt service reserve that arise from a cash flow sweep; and (6) transferring amounts from reserve built up during the construction period.

In general, a debt service account should be modelled in an analogous manner to debt issues where an opening balance, additions and subtractions, a closing balance and interest income (instead of interest expense) are set-up. A technique that simplifies modelling of debt service reserves is to first establish the required amount that should be in the debt service reserve. Since the DSRA balance should equal the required balance, the net inflows to the account (a negative amount on the cash flow statement) can be established where by the inflows are the opening balance less the required balance. Steps to compute the debt service reserve account are described below:

Step 1: Compute the amount of the required debt service reserve from the next period fixed debt service as described above (show two rows – one for the current debt service and another for the next period debt service).

Step 2: Subtract the opening balance of the DSRA balance (computed below) to determine positive or negative amounts that that are required to be deposited or can be withdrawn from the account. In period before construction ends, the required debt service is the debt service from the first operating period and the opening balance is zero, implying that the required funding is the first period debt service.

Step 3: Set-up the opening balance, deposits and removals from the DSRA account. Include a line item for withdraws from the account that are used to fund deficit cash flow.

Step 4: In setting up the funding needs, include the amount required to be funded in the DSRA by multiplying the required funding by the construction phase switch.

Step 5: Include a line item in the cash flow statement for net inflows into debt service reserve (note that this amount can be negative when amounts are withdrawn because the required balance declines and/or falls to zero at the end of the debt life.) Compute a sub-total line in the cash flow statement as the cash flow before debt service reserve account flows. If this amount is positive,

then the DSRA can be funded (or amounts can be withdrawn) up to the amount that is required as illustrated below:

MIN(MAX(cash flow for DSRA,0), Required DSRA Funding)

Step 6: Include a subtotal line after the payment of debt service to reflect the potential for negative cash flows that arise. Once the negative cash flows are computed, evaluate whether the amount can be met from the reserve balance. The formula is shown below:

MIN(opening balance of DSRA, MAX(-cash flow,0))

The set-up of a DSRA account using these steps is illustrated below.

Timing	Show Comments	Onshore							
Start date				1-Jan-16	1-Feb-16	1-Aug-16	1-Feb-17	1-Aug-17	1-Feb-18
End Date		30-Nov-12	30-Nov-12	31-Jan-16	31-Jul-16	31-Jan-17	31-Jul-17	31-Jan-18	31-Jul-18
Reserve Accounts									
DSRA									
Required b/ce for DSRA									
Debt service (repayment of debt + interest expense)				-	3,752.46	3,804.97	3,726.20	3,804.97	3,726.20
Next period DS.				3,752.46	3,847.78	3,770.99	3,849.05	3,772.83	3,850.94
Months of DS.		6.00		1.00	1.00	1.00	1.00	1.00	1.00
TOTAL required DSRA				3,752.46	3,847.78	3,770.99	3,849.05	3,772.83	3,850.94
Less: op b/ce of DSRA	*check*			-	3,752.46	3,847.78	3,770.99	3,849.05	3,772.83
Total required	*check*			3,752.46	95.32	- 76.79	78.06	- 76.22	78.10
DSRA									
op b/ce				-	3,752.46	3,847.78	3,770.99	3,849.05	3,772.83
net funding				3,752.46	95.32	- 76.79	78.06	- 76.22	78.10
withdrawls for cash flow				-	-	-	-	-	-
cl b/ce				3,752.46	3,847.78	3,770.99	3,849.05	3,772.83	3,850.94
Annual Interest Income Rate		0.00%		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Periodic Interest Income Rate				0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Inerest Income									

Avoiding Circular References in funding DSRA through Separating Construction Debt from Permanent Debt

The level of the DSRA account depends on the debt commitment which in turn depends on the cash flow. The cash flow (except for the interest income which was addressed above in the sculpting discussion) does not depend on the DSRA. Despite this fact shown in the diagram below, the DSRA often seems to result in hopeless circularity. This circularity generally creates a messy copy and paste macro that makes the model a lot less flexible.

Debt Service Reserve	→	Debt Sculpting
Debt Sculpting	→	Operating Cash Flow (CFADS)
CFADS	<>	Debt Service Reserve

The debt funding drives the debt service which in turn drives the size of the DSRA. However this is not a real circularity problem because the debt commitment is independent of the DSRA and in terms of funding during construction, the DSRA simply re-allocates the funding between construction and other uses.

Problems of circularity associated with the DSRA and the funding process can be avoided by separating the construction financing from the term or permanent financing after the construction period. The debt service is driven by the term financing and the amount of debt in the term financing must be determined by the independently computed debt commitment from the sculpting analysis. The process of avoiding circularity associated with the DSRA is the following:

Step 1: Separate the construction debt from the term debt through creating a separate facility that is paid off at the period before the commercial operation date. For the construction debt,

the repayment at the end of the construction period can be modelled using a timing switch and summing the opening balance plus draws and capitalised interest and fees for the period just before commercial operation.

Debt repayment = (Opening Balance + Draws + Capitalised Interest and Fees) x Switch

Step 2: Create a separate account for term debt where the amount of the loan that is issued comes not from the payoff of the construction debt but comes from the loan commitment defined by the sculpting process.

Term Debt Issued = Commitment from Sculpting x Switch for End of Construction

Step 3: Include the DSRA in the funding requirements that drive the amount of debt and equity financing (or assume that the DSRA is entirely funded by debt). When the DSRA is included in the funding requirements, then a circular reference does not arise because the DSRA comes from the debt commitment and does not have anything to do with the financing itself.

Funding = Construction + DSRA Funding Needs x Switch

Avoiding Circular References due to Cash Flow Sweeps and the DSRA

A cash flow sweep seems to create an impossible circular reference in modelling the DSRA because the prospective interest expense depends on the current end of period debt balance which is driven by the current year cash flow that depends on the DSRA itself. The reason this is not in fact a circular reference is that DSRA terms in the loan agreement do not require a forecast of uncertain prospective cash flow in order to project the interest expense and then size the DSRA. Rather, the information available for sizing the DSRA is the interest expense computed from the opening balance of the loan.

By thinking about the formula for the next period debt service, the circular reference problem can be eliminated. The current level of interest is the beginning balance of the debt multiplied by the interest rate. In the next period, the interest expense declines as the debt is repaid. This means that the next period interest can be defined as the opening balance of the debt less the next period repayments multiplied by the next period interest rate.

Current period Interest = Opening Debt Balance x Interest Rate

Next Year Interest = Closing Debt Balance x Interest Rate (Next Period)

Next Year Interest = (Opening Debt Balance – Repayment) x Interest Rate

The last equation above is the crucial calculation for the debt service reserve calculations in the presence of a cash flow sweep. Using this equation as the interest component of future debt service where the debt repayment does not depend on the future cash flow (which should be the case because the debt service reserve calculation does not depend on the estimating cash flow) then the next year interest does not depend on the cash flow. Further, the debt repayment should be fixed in advance as a function of the sculpting process.

Major Maintenance Reserve Accounts

In project financing and sometimes in other transactions, lenders require cash reserves to be set-up to accumulate money for the prospective payment of major maintenance expenditures. Examples of such expenditures include the overhaul of a wind turbine or the periodic re-surfacing of a toll road. These reserves generally cause the rate of return to be a lot lower as the earnings on the cash account should

be much less than either the equity return or the interest rate (the cash is sleeping). The developer of a project may complain that he must pay an interest rate of seven percent to borrow money that is put right back into the bank and only earns an interest rate of two percent. At first blush it seems that the modelling of these reserves is not a very complex matter – one can just add a switch for the maintenance period and then assure that enough money is accumulated in the reserve accounts to assure that funds will be available to pay for the maintenance. Unfortunately, there are pesky programming issues with testing for the maintenance period, computing the contributions to the reserve by looking forward to the prospective maintenance period, and adjusting for the final portion of the life of a project after which maintenance will not be required. Programming techniques that are useful for calculating the reserves include establishing a switch for the maintenance period, creating a counter to track the remaining periods until the next expenditure, using the OFFSET function to find the prospective amount of money required for the reserves and using the debt repayment so that contributions do not occur for expenditures after the debt is repaid.

Case 1: Simple Case with Constant Time Period Increments and Constant Expenditures

To demonstrate programming issues associated with maintenance reserve accounts, a simple case is presented first where complications of (1) changing maintenance expenditures in future periods; (2) final expenditures in a different period from the final debt payment; and (3) varying time periods between expenditures. In this case the OFFSET function is not necessary and the principal issue involves simply finding the period of the expenditure. The inputs for this case are the amount of the expenditure and the time period between expenditures. In this simple case where maintenance occurs on a regular basis and the amount does not change, the step by step process includes:

Step 1: Calculate a switch variable for the maintenance period. To do this, create a switch that uses the MOD function that computes the remainder between two numbers. The MOD function can be used with the variable that measures the age of the project and the maintenance period as illustrated below. When the MOD function is zero and the switch is TRUE, then either the period is a maintenance period. This switch is referred to as the Mod switch in the discussion below.

MOD(period, maintenance period) = 0

In addition to this switch, another switch that does not include any periods during prior to the commercial operation date should be computed. This can be accomplished through multiplying the first switch by the operating period as illustrated below:

Maintenance Switch = Mod switch x Operating Period Switch

Step 2: Compute the spend amount and the contribution to the MRA

Once the maintenance switch is computed, the total amount actually spent as well as the contributions to the MRA can be established. The total amount spent is simply the constant expenditure multiplied by the switch. The contribution is the total amount spent divided by the time periods between the expenditures. This amount should also be multiplied by a debt repayment switch as contributions are not generally required for expenditures that occur after debt repayment.

Case 2: Case with Constant Time Period Increments and Changing Expenditures

If the expenditures are not the same in each period -- for example expenditures increase with inflation -- then the problem of determining MRA contributions becomes a lot more complex. The complexity comes about because of the necessity to look forward to see what to expenditures will be to determine current contributions. Beginning at the commercial operation date when cash flow is generated, contributions to the MRA should reflect the next expenditure which may occur in five or more years into the future. When it is required to look forward or backward from a cell, the OFFSET function is useful. In order to use the OFFSET function, the number of periods until the next expenditure should be counted. For example, if

the number of periods between expenditures is ten (five years with semi-annual modelling), then a counter beginning with one and ending with ten should be established. Once the counter is developed, this number should be subtracted from the total time periods between the expenditures yielding the remaining periods until the expenditure. In this way, the remaining periods until the next expenditure should be zero for the period of the expenditure.

The MRA contribution can be adjusted so that no funding is made for expenditures that occur after the debt repayment period. To do this, the amount of the expenditure can be multiplied by the debt repayment switch before the OFFSET function is used. Through adjusting the basis for the OFFSET command by the debt repayment switch, the last expenditure does not have to be in the final debt repayment period. Finally, a test variable can be established to make sure the MRA balance is zero at the end of each spend period. Steps to accomplish the MRA contributions and withdrawals with varying expenditures are shown below:

Step 1: Use the MOD function as above to determine the spend periods

Step 2: Enter the time periods between expenditures as a row in the spreadsheet

Step 3: Use the spend period switch as the basis for computing the number until the next spend. As with the period counter used in computing the age variable, re-set the counter variable one when an expenditure occurs. For the counter to accumulate to the time period between expenditures, a counter variable can be created as illustrated below.

Counter = IF(spend switch, 0, last counter + 1)

Step 4: Compute the periods until the next spend as the total periods between expenditure minus the period counter above. This variable is necessary for the OFFSET function.

Remaining Periods = Total Periods Between Spend - Counter

Step 5: Calculate the total expenditure using an inflation rate through multiplying the total inflated expenditure by the inflation index. This expenditure should be multiplied by the debt repayment switch so that no reserve is accumulated for expenditures after the debt is repaid.

Spend Subject to MRA = Expenditure x Debt Repayment Switch

Step 7: Use the OFFSET function to compute the required future expenditure. The OFFSET function can be developed by using the adjusted expenditure as the reference cell and then moving to the right by the remaining periods until the next expenditure.

Prospective Expenditure = OFFSET(Spend Subject to MRA,0,remaining periods)

Step 8: Divide the future required expenditure by the total number of periods between the expenditures. Use an IF test to assure that a divide by zero does not occur.

MRA Contribution = Prospective Expenditure/Periods Between Spend

Step 9: Compute the MRA balance and then make a test variable to assure that the account goes to zero in the spend period. The formula for this test is illustrated below.

Test = IF(Spend Switch, Closing MRA = 0, TRUE)

Case 3: Case with Varying Time Period Increments and Changing Expenditures

The above example assumed expenditures were made in the same time increment and does not allow varying time periods between expenditures. If the expenditures occur with varying time periods as illustrated below, the problem becomes more complex. Instead of simply entering the time period between expenditures as an input, the varying time periods must be derived from input dates. This variable should be the periods between the expenditures should be the amount from the prior increment in the year of the expenditure. For example, if there are ten periods between commercial operation and the first expenditure but there are five periods between the first and second expenditure, then the time period for the first expenditure should be ten and not five. This can be developed through using the MATCH function using the previous date together with the INDEX function that finds the time period for the next increment.

Date	Expenditure	Periods From Prior
1-May-12		
1-May-17	3,000	10.00
1-May-23	3,500	12.00
1-May-27	3,300	8.00
1-Nov-34	4,200	15.00
1-Nov-39	3,500	10.00
1-May-47	2,000	15.00

Given that the time period between expenditures varies, the MOD function cannot be used in this example. However, the counter between periods and OFFSET function can be used in a similar manner as above. To find the expenditure period, a VLOOKUP or MATCH function can be used with the FALSE switch. When results of the result of the VLOOKUP or the MATCH is a number rather than a #N/A, a maintenance spend period is occurring. If the result of the MATCH or LOOKUP is #N/A then there is no expenditure. Therefore, the ISNUMBER function can be used to make the expenditure switch – when there is a number, the ISNUMBER function produces a value of TRUE and for the #N/A values the ISNUMBER produces a value of false. Steps of the process that are different from the above process are summarized below.

Step 1: Use the VLOOKUP or MATCH function (exact match) combined with the start date to find the expenditure for the period. In periods other than the spend period the result is #N/A.

Step 2: Enter the SWITCH variable for the maintenance spend period (TRUE if a spend period) by using the ISNUMBER function (ISNUMBER(step1 result).

Step 3: Match the prior date in the model with the date of the MRA input. The prior date is used because the periods from the prior expenditure should change in the period after the spend switch (alternatively, you can set-up the inputs with the prior months next to the date).

Step 4: Use the index with the MATCH, but begin from the second row and continue for one blank row. This is necessary because the time between periods is the prospective period.

Step 5: Compute the period counter, the remaining period and the prospective spend in the same way as above.

An illustration of the process for computing the maintenance reserve is shown on the table below. The various rows correspond to the discussion above. As with other issues, there is an exercise on the DVD and the website that allows you to work through the formulas yourself.

Period		0	1	2	3	4	5	6	7	8	9	10	11	12
Months in Period		6	6	6	6	6	6	6	6	6	6	6	6	6
Start Date			1-May-12	1-Nov-12	1-May-13	1-Nov-13	1-May-14	1-Nov-14	1-May-15	1-Nov-15	1-May-16	1-Nov-16	1-May-17	1-Nov-17
End Date		30-Apr-12	31-Oct-12	30-Apr-13	31-Oct-13	30-Apr-14	31-Oct-14	30-Apr-15	31-Oct-15	30-Apr-16	31-Oct-16	30-Apr-17	31-Oct-17	30-Apr-18
Operating Period		FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Spend Peiod		TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
Periods Between Spend		6	6	6	6	6	6	6	6	6	6	6	6	6
Period Counter for MRA		1	1	2	3	4	5	6	1	2	3	4	5	6
Remaining Periods until Next Spend		5	5	4	3	2	1	0	5	4	3	2	1	0
Periodic Inflation		0.00%	2.47%	2.47%	2.47%	2.47%	2.47%	2.47%	2.47%	2.47%	2.47%	2.47%	2.47%	2.47%
Periodic Inflation Index		1.00	1.02	1.05	1.08	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34
Inflated Spend		1,000.00	1,024.70	1,050.00	1,075.93	1,102.50	1,129.73	1,157.63	1,186.21	1,215.51	1,245.52	1,276.28	1,307.80	1,340.10
Spend Amount		0.00	0.00	0.00	0.00	0.00	0.00	1,157.63	0.00	0.00	0.00	0.00	0.00	1,340.10
Debt Repayment Switch		FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Spend Amount Subject to MRA		0.00	0.00	0.00	0.00	0.00	0.00	1,157.63	0.00	0.00	0.00	0.00	0.00	1,340.10
Prospective Spend for MRA Contribution		0.00	1,157.63	1,157.63	1,157.63	1,157.63	1,157.63	1,157.63	1,340.10	1,340.10	1,340.10	1,340.10	1,340.10	1,340.10
MRA Contribution		0.00	192.94	192.94	192.94	192.94	192.94	192.94	223.35	223.35	223.35	223.35	223.35	223.35
MRA Balance														
Opening Balance		0.00	0.00	192.94	385.88	578.81	771.75	964.69	0.00	223.35	446.70	670.05	893.40	1,116.75
Add: MRA Contributions		0.00	192.94	192.94	192.94	192.94	192.94	192.94	223.35	223.35	223.35	223.35	223.35	223.35
Less: Spend		0.00	0.00	0.00	0.00	0.00	0.00	1,157.63	0.00	0.00	0.00	0.00	0.00	1,340.10
Closing Balance		0.00	192.94	385.88	578.81	771.75	964.69	0.00	223.35	446.70	670.05	893.40	1,116.75	0.00
Test		TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Aggregate Test	TRUE													

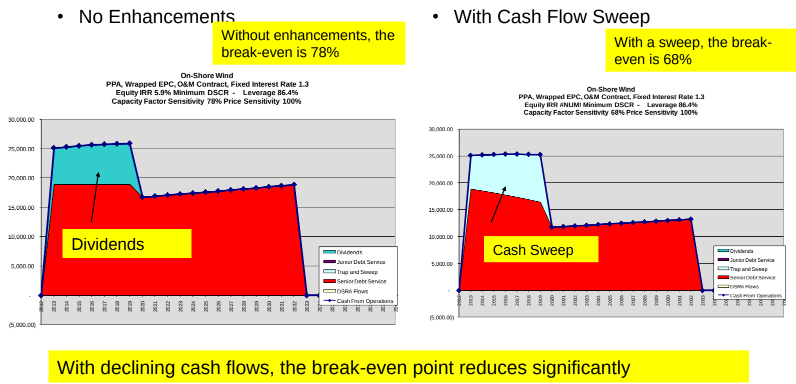
Covenants and Cash Sweeps

In negotiating with lenders, one of the subjects that must be analysed is the level of covenants and cash flow sweeps. Covenants can range from mandating that equipment is in good working order to strict limitations on payment of dividends. For modelling purposes, it is the latter type of negative financial covenants that should be incorporated in a model. These covenants can affect returns to equity investors because they affect the timing of cash flows that are allowable to be paid out as dividends. The covenants can take the form of cash flow traps that limit dividends when times are bad (and there is not much cash flow available for dividends anyway.) Alternatively, the covenants can be in the form of cash flow sweeps which limit the cash flow that limits the cash than that can be distributed when times are good.

Covenants do not change the operating cash flow of an investment and can only change the timing of who receives the money and in what order. With more restrictive covenants, the equity holders must wait while without the covenants, the equity holders can receive cash flows earlier. The timing of equity cash flows can have relatively large effects on the equity IRR and assuring that cash flows accrue to lenders before equity holders can reduce the risk to holders of debt.

A financial model should be able to assess the trade off between risk and return of covenants and cash sweeps. For example, the model can be used to assess how much the operating income can decrease with and without a covenant to evaluate the effectiveness of the covenant. If the covenant allows the operating to decline by a wide margin more than the operating income can decline without the covenant, than the covenant is effective in reducing risk. The efficacy of the covenant depends on the structure of the cash flow. If cash flow is increasing over time, the covenant will not be effective in reducing risk. If the cash flow "falls off a cliff" after a few years, the sweep and covenants can be effective. A summary of the analysis of covenants and sweeps is illustrated below.

Effect of Cash Sweep With Declining Cash Flows



The mechanics of modelling covenants are analogous to calculating defaults as described above. In particular, the debt schedule is tied to the cash flow statement. In the case of covenants, the cash that is not allowed to be paid in dividends can be either used to pay of debt earlier than scheduled or alternatively, it can be placed in a cash reserve account depending on the language of loan agreements. If cash is used to pre-pay debt, the cash that is trapped should be included in a line item in the debt schedule. If the cash is applied to a reserve account, a separate account should be set-up the debt module of the model. The step by step process below describes how to incorporate a cash trap or a cash sweep covenant into a model.

Step 1: In the cash flow statement, add sub-total rows that show the cash flow that is available for a cash sweep or a cash covenant.

Step 2: Include a test in the model that evaluates how much of the cash that is available for the cash sweep or cash trap will be unavailable to pay dividends or other subordinated debt. This may be a test against the debt service coverage ratio in the case of a cash trap covenant or a test against a debt to EBITDA ratio in the case of a cash sweep covenant in a leveraged buyout.

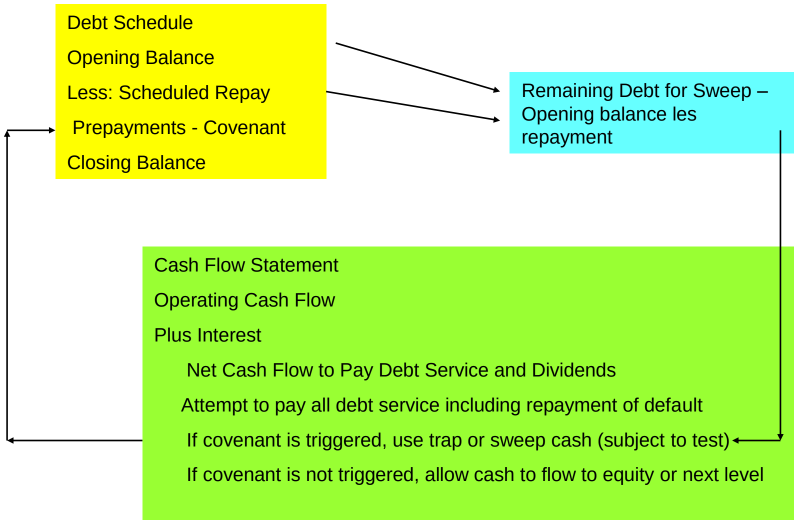
Step 3: Use a covenant test to determine the amount of cash trapped or swept in the cash flow statement. The test could be whether the DSCR is below the covenant in the case of a cash trap, or it could be a multiplication of a cash sweep percentage.

Step 4: In the cash flow statement where a line item lists the cash flow sweep or cash flow trapped, the line item should include a minimum function to assure the most cash that is trapped is the amount of debt outstanding.

Step 5: The cash flow that is trapped or swept must be applied to something. One option is to use the cash to pre-pay debt and the second is to build-up cash in a reserve fund. If cash is used to pay down debt, then as long as the minimum function is used in the repayment analysis, then the debt will appropriately be paid earlier. If the reserve account is used, then an item must be added that releases cash from the reserve when the covenant is met or the debt is repaid.

The diagram below illustrates how process for covenants or cash flow sweeps works in terms of linking the cash flow statement to the debt schedule. (Note that if the cash flow from the cash sweep or the cash trap is applied to a reserve account, the proceeds are used as cash inflows into the cash reserve.) The intermediate box in the diagram demonstrates that evaluation must be included somewhere in the model to assure that the cash flow sweeps are not pre-paying more debt than is outstanding – if all of the debt is paid, there is no longer a reason to sweep any cash. If a cash sweep or a covenant is implemented, then the cash that is prevented from paying dividends can either be used to pre-pay debt or put into a reserve account. For debt holders, prepaying debt is more favorable from a credit perspective because it permanently reduces debt while money in a reserve account can be used to pay dividends before debt is

repaid. Mechanically, the programming of sweeps and covenants is similar to modelling of defaults in terms of connecting the debt schedule to the cash flow statement. Structuring provisions on debt such as cash lock-ups and sweeps limit distributions to equity in different ways. Discussion of the reason for covenants and sweeps in alternative transactions. How much they really protect the debt holder and harm the debt holder. The effect in alternative transactions – project finance and leveraged buyouts. Modelling issues.



As with the discussion above, to avoid circularity, use the prior year debt service coverage ratio. When developing the model use the prior. If the terms require forward DSCR or current DSCR, then compute a fixed line and use a circularity resolution method.

Appendix:
Unique Challenging Issues in Real Estate Modelling Involving Portfolio of Assets, Progress Payments and Lease Rolls

Real estate analysis and modelling encompasses a mixture of aspects from both corporate finance and project finance. Analysis of a hotel project or a commercial building is closely related to project finance modelling and analysis as the project moves through different stages; revenue and contracts are important; and the financial analysis is driven by cash flows rather than profits. On the other hand, the real estate projects have less of a defined life; they rely on rental market history and are often valued at some arbitrary terminal date which makes them more like corporate analysis. Analysis of other real estate projects such as residential and commercial mixed development projects have things in common with corporate analysis in that a portfolio of projects with different cash flow patterns and risks is financed and the residual values at some terminal date is evaluated. However even in these portfolio investments, the individual components of the mixed development projects are evaluated much like project finance. The structure of real estate projects affects the type of ratios used to evaluate the credit quality and the equity value of the projects. Because of the indefinite life and the ability to sell projects, the loan to value ratio is used in lieu of the DSCR in project finance. However, the debt to capital ratio from accounting statements is not as relevant as it is for traditional corporate analysis. Unlike corporate analysis where the net present value of free cash flow is used to evaluate investments, real estate projects rely on the IRR realized by different investors as in project or structured finance.

There are other projects that have some of these characteristics of real estate projects. One very similar case is the analysis of solar roof-top projects where multiple solar projects are added to a portfolio. Given

that real estate falls somewhere in-between corporate finance and project finance, many issues associated with real estate and financial institution models are covered in describing the four general model categories above. For example, consider a real estate analysis where properties are held for a few years and then are assumed to be sold at multiples (called cap rates). This type of analysis has many characteristics of a project finance model where the construction period and the operation period must be distinguished. It also includes elements of corporate modelling where flexible holding periods and terminal period analysis plays an important role.

Despite similarities with corporate and project finance models, there are some unique and difficult issues associated with the models that include:

- Structuring portfolios of real estate projects in which each project has different start dates; holding periods and construction profiles;
- Incorporating dates that do not begin at the beginning of period in a quarterly or monthly model as the dates of individual projects in a portfolio can differ;
- Computing the payments received from residential properties when the payments are derived from progress payments along with assumptions with respect to how the residential properties are marketed.
- Calculating the distribution of capital expenditures (S-curves) that are flexible enough to reflect different construction periods as well as the manner in which expenditures are spent over time.
- Reflecting a portfolio of leases with different lease terms, potential idle time periods and renewal probabilities.
- Programming unique aspects of financing a portfolio of different projects where some projects are producing cash flow while other projects require financing of capital expenditures.

In explaining how do deal with these somewhat painful issues, this appendix assumes that you have reviewed the sections that address project finance models related to setting-up project phases and time periods and describes some features of a real estate model that are different from a project finance model. Differences in the structure of real estate models include:

- In modelling a single project such as a multi-family development or a hotel, the sale of a project after a given holding period is often modelled and the features of debt are different from typical project finance models.
- In modelling developments that include a portfolio of different projects, cash flow is generated before construction of all of the projects is completed. This means that a separate sources and uses analysis is not a good way to structure models as it is with for project finance analysis.
- In modelling real estate projects, there are often multiple different units and buildings which are completed at different times. To consolidate projects with different start and end dates, separate project by project can be established using a common master time line for all projects. The switch variables are then all adjusted to the common master time line.
- In modelling commercial real estate investments, the analysis should include the effects of different lease terms with alternative expiry dates. Modelling idle time and lease renewals can result in long and non-transparent formulas.

- Some real estate projects have multiple participating tranches with different return targets and sharing mechanisms

Modelling a Single Project

An effect way to understand a real estate project is first to model a single project and then later to put projects together in a portfolio described below in the section on mixed development. Modelling a single project is very similar to modelling project finance with the exception that a holding period is defined after which the project is sold. Operating inputs that drive the value of the project include the occupancy rate that varies with the life of the project, the rental rates which can be volatile, occupancy rates that are correlated with the rental rates and fixed and variable operating expenses. In selling the project a time period switch can be established for the terminal period. To define the sale price, a capitalization rate is generally used. The capitalization rate is the value of similar projects that are bought and sold in a market divided by the pre-tax cash flows. For example if a project is sold for 10,000 and its rental revenues net of operating expenses are 500, the capitalization rate is 500 divided by 10,000 or 5%.

Rather than using the total project life to measure the operating period as in other project finance models, the operating period is generally defined by the holding period before which the project is sold. Then, similar to the acquisition model described above, the project is sold after the holding period. This can be accomplished through dividing the cash flow by the cap rate which is a percentage and also by a terminal value switch (the terminal value switch is simply a TRUE/FALSE logical variable that is defined with the formula = (period = holding period). The theory behind the cap rate is very similar to the ideas underlying computing the terminal value using the final year cash flow divided by the cost of capital minus the growth rate. The cap rate reflects both the cost of capital and growth rate. For example if one believes the growth rate in rents is 2.5% in a market and the cap rate is 5%, then the implied cost of capital is 7.5% (cap rate = (WACC – g) which means that WACC = cap rate + g). With a higher growth rate the cap rate should be lower and if the cash flows are less risky (for example, if there are fixed leases) then the cap rate is also lower.

Once the proceeds from selling an asset are computed (net of fees and other transaction costs) a couple of accounting and tax issues arise. For tax purposes a capital gain is generally computed as the sales proceeds less the net book value of the fixed assets. The capital gain is the sales proceeds less the Once the rate of return in a real estate model is computed – the equity and project return. Real estate debt can take many forms as with project finance debt, but when the project is sold at the end of the holding period, the debt must be repaid. In addition, when the project is sold, the fees and taxes on the gain on sale should be accounted for.

Cash Flow Generated Before Completion of Construction, Sales Rates and S-Curves

In some real estate projects, projects are held for trading rather than investments. In these cases, cash flow is generated from receiving progress payments before construction is complete. This cash generated from selling a project reduces the need for additional debt. Further if the proceeds are more than the total amount of debt required, the cash is deposited into a reserve account. If there is money in this cash reserve account and future financing needs occur, then the reserve account is used for future cash needs. This cash process can be modelled in a similar way as the cash process that was described in a standard corporate model where deficit cash flow is funded by raising new debt and surplus cash goes to retiring cash and/or reducing debt.

Modelling a portfolio of different projects

The complex and challenging aspects of real estate modelling come about because multiple projects are often put together into a combined portfolio. When creating such a project you would like to be able to change the occupancy dates, the construction dates and the S-curves, timing or proceeds selling from residential projects and other items of different parts of a portfolio. To program different projects in a portfolio, reflecting different time periods can be accomplished by using the following general ideas:

First, establish a start date for the whole model with the portfolio of all of the projects. This start date is the basis of a time line that will used for all of the individual projects. If each column of the spreadsheet has the same date, then one can eventually add up all of the separate projects to obtain the aggregate cash flow for the calendar period. In the project finance models discussed above, the start date of the model and the start date of the construction (or development) are the same.

To create a portfolio of projects you can either use a INDEX and data table method, or model the individual projects. The latter method of displaying individual projects is more transparent and can be more flexible. Effectively applying this method can be accomplished with some effective functions. These functions include:

1. A function that computes the percent of a period a project is in operation or under construction through comparing begin and end dates of a project with start and end dates of the timeline. The important and tricky aspect of this function is to compute the portion of the period for the first and the last periods.

2. A function that computes the temporary occupancy date (TOP) of a project given the S-curve so that one can enter different S-curves and derive different TOP dates.

3. A function that computes the revenue received in a residential project given both the progress payment schedule and the sales or marketing schedule. Some projects may receive the whole series of progress payments and other residential projects that are sold later receive the revenues later and must accumulate the payments that were scheduled.

Second, develop a template model that can be used to compute the operating cash flow for each project. To make a template that works for each individual project, you can use the INDEX function along with a code number for each individual part of the portfolio. In the simple example presented below, the index command would be used to define the cost, the sale price, the construction profile and the period finished for the three components of the project. A single cash flow model would be set-up that uses the different cost, sales price and other inputs. If the inputs are set-up in a structured manner with items such as the completion date, the cost, the lease rate, the capitalization rate, the utilization rate and other factors, the amounts can be extracted for each separate project. In addition to the input data for individual projects, general assumptions should be made for factors such as the general inflation rate.

Assumptions								
		Code	Cost	Sales Price	Constr Profile	Period Finished		
Residential Type 1		1	1,000.00	1,500.00	3	1-Jan-12		
Residential Type 2		2	2,000.00	2,500.00	2	1-Jan-15		
Commecial		3	3,000.00	3,200.00	1	1-Jan-15		
Period		-5	-4	-3	-2	-1	0	Total
Profile 1	1	0%	0%	0%	25%	50%	25%	100%
Profile 2	2	0%	0%	0%	0%	50%	50%	100%
Profile 3	3	30%	25%	20%	10%	10%	5%	100%

Third, after the common start date is established, compute the period code. This is done through comparing the commercial operation date (called the temporary occupancy date in real estate) and the common start date. Using the inputs in the above example, the period code would be different for the first and the second project – it would be a larger negative number for the project with the further out date. This is analogous to computing the construction periods discussed above for the project finance model. Recall that if a periodic model is used, the DAYS360 function can be applied. (If the days in a 360 day are known and the model is computed on a monthly basis, then the DAYS360 command should be divided by 30.)

To see how this process works, assume that the common start date is 2012 and that there are two operating components. The first has a start date in 2014 and a two year construction period and the

second has a start date of 2015. Both have a cost of 1,000 and a two year construction period. In this case the first period for the initial project is -1 and the first period for the second project is -2. The construction period is -1 and 0 for both projects. Since -1 is in the first year for the first project and it is the second year for the second project, the construction expenditures are arrayed differently. The manner in which the model for individual components can be set up is illustrated below. In the table below, the period code is used to define the S-curve table that defines construction expenditures as a function of the period code. The S-curve can is established by using an HLOOKUP table.

First Project													
Number	1												
Residential Type 1													
Commercial Date	1-Jan-12												
Periods Prior to Operation	5												
First Period	-4												
Profile Index+1	3												
Cost	1,000.00												
Price	1,500.00												
Period Code		-4	-3	-2	-1	0	1	2	3	4	5	6	7
Construction Profile		0.25	0.2	0.1	0.1	0.05	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Construction Profile		0.25	0.2	0.1	0.1	0.05	0	0	0	0	0	0	0
Cost		1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00
Construction		250.00	200.00	100.00	100.00	50.00	-	-	-	-	-	-	-
Cash Proceeds from Sales Price		-	-	-	-	-	1,500.00	-	-	-	-	-	-
Revenue Recognized - Pct of Completion		375.00	300.00	150.00	150.00	75.00	-	-	-	-	-	-	-

Once the individual cash flow model is established, the amounts from the individual parts should be aggregated in creating a financial model. The aggregation can be accomplished by using the data TABLE function. The code for the individual project is the column sensitivity in the data table and the column input is the number used in defining the INDEX function. In the above example, the column input is the cell reference for the number 1. Simply add the cash flows for different projects using a date code that begins with the overall model start date that was used to compute the period code for each project. The manner in which the data table can be used to aggregate cash flows from individual projects is illustrated in the table below.

Cash Flow Analysis											
Total Proceeds from Sales											
Residential Type 1	-	-	-	-	-	1,500.00	-	-	-	-	-
1 Residential Type 1	-	-	-	-	-	1,500.00	-	-	-	-	-
2 Residential Type 2	-	-	-	-	-	-	-	2,500.00	-	-	-
3 Commecial	-	-	-	-	-	-	-	-	-	-	3,200.00
Construction Expenditures											
Residential Type 1	-	-	250.00	500.00	250.00	-	-	-	-	-	-
1 Residential Type 1	-	-	250.00	500.00	250.00	-	-	-	-	-	-
2 Residential Type 2	-	-	-	-	500.00	1,000.00	500.00	-	-	-	-
3 Commecial	-	-	-	-	-	-	-	750.00	1,500.00	750.00	-
Net Cash Flow											
1 Residential Type 1		-	(250.00)	(500.00)	(250.00)	1,500.00	-	-	-	-	-
2 Residential Type 2		-	-	-	(500.00)	(1,000.00)	(500.00)	2,500.00	-	-	-
3 Commecial		-	-	-	-	-	-	(750.00)	(1,500.00)	(750.00)	3,200.00

Once the cash flows are aggregated, the financial model can be developed. Since there are multiple parts with different construction and cash flows, the model should not necessarily begin with a sources and uses statement. Instead, a working capital facility and a debt facility can be developed for situations when the cash flow is negative. Similarly, a routine can be developed to issue equity before or after the issuance of debt. Methods to develop the debt schedule and a cash flow statement with a waterfall involving structuring the cash flow statement and using the MIN and MAX functions is described above.

The general idea of establishing the size of debt and the debt capacity is an important issue in risk analysis and cost of capital (chapter 4). In determining the amount of debt that can be supported by a

company or a project, one cannot generally boil the analysis down to a simple formula such as setting the debt service coverage ratio to 1.6 in order to obtain a BBB bond rating. Once the process of setting some financial ratio to a benchmark level has been established, the mechanical process depends on how the level of debt is computed in a model. A simple approach is to compute the debt level from a given leverage ratio through multiplying the total uses of funds by the ratio. This method can lead to circularity problems because the amount of the fees and the interest during construction drive the uses of funds. This method does not conform to reality and it does not allow computation of items such as commitment fees, up-front fees and required funding of cost over-runs.

The Painful Problem of Beginning a Model with Dates that do not start at the Beginning of a Quarter or a Month or a Year

In most situations an acquisition or a project finance venture or even a valuation analysis with a corporate model does not conveniently begin on January 1st of a year for annual models, or April 1st, July 1st or October 1st for a quarterly model and the beginning of the month for a monthly analysis. Many times it is not worth the effort to incorporate start dates that are not the beginning of a period and one can simply assume the project or acquisition occurs that the beginning of the relevant period. However, occasionally it may be necessary to incorporate start dates that are not at the beginning of a period. Unfortunately, this is a painful process and there is no quick and easy trick to accomplish the task. A general approach to deal with the issue of start dates that are do not come at the beginning of a month or quarter is discussed below:

1. First, you should establish the date of the first full period of a model. For example, if the commercial operation date or the financial close date is 19th of January and the model is a monthly model, then the date of the first full period is 1st of February. On the other hand, if the model is a quarterly model, the first full date is 1st of April.

2. The date of the first full period can be determined by using the EOMONTH function and the LOOKUP function to compare with dates that correspond to the end of a year, quarter or year. To do this you can create a list of dates using the EOMONTH function. Then the LOOKUP function (described below) can be used together with this list to find the beginning of the first full period. For example, if the first project begins on 19th January and the fiscal year is June and an annual model is used, then the beginning of the first month can be computed by comparing 19th January with a list of dates beginning with the first of the month. In this case the 1 February would be selected.

   This date is used as the end of the first period and the beginning of the second period. Once the second period is established, the end dates of subsequent periods can be established as described above using either the EDATE or EOMONTH function in the same way as above.

3. Given that periods of the model will be uneven – specifically that the number of days in the very first period is different from days in the other periods, the technique that computes daily growth rates and then compounds the growth on a daily basis should be applied as described below.

4. If you are entering factors that depend on the life of a project or the life of an acquisition – for example the growth rate for the first year of an acquisition may be negative – one must allocate the growth between periods. This occurs in periods when the year changes. For example, if the project begins on 1st September and the model is annual, some of the first year growth rate must be allocated to the second full year of the model. To accomplish this one can create a partial year factor and compute the percent of the period attributable to the current age and the percent of the project attributable to the prior age.